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A Revision of the Genus *Brachygastra* (Hymenoptera: Vespidae)¹

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ABSTRACT

This paper is a taxonomic revision of the genus *Brachygastra*, which occurs in Central and South America. Twelve species are recognized. *Brachygastra fistulosa* is new, and *B. smithii*, *B. propodealis*, *B. mellifica* and *B. borellii* are elevated to specific rank. Eleven varieties are placed in synonymy and their status in taxonomy is discussed. All species are described and the available knowledge of their biology and distribution is summarized.

INTRODUCTION

Recent treatments (Bequaert 1933, 1943, 1944) of the genus *Brachygastra* (= *Nectarina*) have concerned only a few species or certain geographical regions. These studies, while contributing much to the knowledge of the genus, have confounded rather than clarified the status of many of the described forms. Approximately 25 forms have been assigned to the genus. Many of these were described as color forms or varieties and some others, although originally described as distinct species, have been considered varieties. The present study is a taxonomic revision of the genus *Brachygastra* and a reevaluation of the various forms in the light of recently acquired material.

The genus *Brachygastra* is one of the common elements of the neotropical fauna. It extends from the southwestern United States (southern Arizona and Texas) to Argentina (Buenos Aires). The species build phragmocytarous nests which in species of the *lechequana* group are perennial and may become very large with populations of as many as 15,000 wasps. In other species the nest does not attain great size and does not appear to last as long. The species are pleometrotic, the nests being founded by swarming, and the

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queens comprising as much as 17% of the population (Buysson, 1905, for *B. lecheguana*).

As the name indicates, the wasps of this genus are best recognized by the short, truncate abdomen which is usually wider than long in preserved specimens. In addition, the scutellum is very high and often projects over the metanotum. The genus closely resembles *Chartergus* and *Pseudochartergus*, to which it is closely allied.

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MATERIALS AND METHODS

Approximately 4,700 pinned specimens have been examined during the course of this study. These are distributed among the species as follows:

	♀♀	♂♂
<i>Brachygastra augusti</i> (Saussure)	467	4
<i>B. azteca</i> (Saussure)	1,031	7
<i>B. baccalaurea</i> (R. von Ihering)	22	0
<i>B. bilineolata</i> Spinola	324	1
<i>B. borellii</i> (Zavattari)	10	..*
<i>B. buyssoni</i> (Ducke)	3	..*
<i>B. fistulosa</i> n. sp.	9	..*
<i>B. lecheguana</i> (Latreille)	890	27
<i>B. mellifica</i> (Say)	1,386	58
<i>B. propodealis</i> Bequaert	8	..*
<i>B. scutellaris</i> (Fabricius)	403	0
<i>B. smithii</i> (Saussure)	102	2

* Males not known.

A large number of specimens is not necessarily indicative of wide distribution of specimens throughout the range of a species since large nest series are often involved.

All measurements were made with the aid of an adjustable eyepiece micrometer on a binocular microscope, calibrated with a stage micrometer. All drawings were made with the aid of an ocular grid.

Descriptions of species in which there is a great deal of geographical variation refer to the condition of the species at the type locality and variations throughout the range are described in a separate section. Characters are numbered to facilitate comparison among descriptions. Ratios and measurements given are means \pm 1 standard error. Descriptions of coloration are given for the forms in which maculations are most developed and the variations are discussed following the description.

Lists of localities are divided into countries and each country into the appropriate subdivisions (Estado, Departamento, etc.). Parentheses indicate that the given locality could not be located on any map or gazeteer examined. Brackets include additional information supplied by me.

Synonymy is given in abbreviated form. A complete listing is available in the thesis in The University of Kansas library.

TERMINOLOGY

Unless otherwise indicated, terminology is that of Duncan (1939).

Size. Although total body length is occasionally indicated, it is no more than a rough approximation as the position of the abdomen varies greatly in preserved specimens. Where indicated, body length is the approximate length of head, thorax and the first two gastral segments in horizontal position ($h + th + terg\ 2$). A more reliable indication of size is the length of the forewing which is measured from the apex of the humeral plate to the apex of the wing.

Punctures and pubescence. As punctures are often diagnostic in the genus, it is important that they are properly understood. Size is indicated relative to width of the median ocellus, *i.e.* small are $\frac{1}{4}$ or less than, medium are $\frac{1}{4}$ to $\frac{1}{2}$, and large are $\frac{1}{2}$ or greater than the width of the ocellus. Density is indicated by average number of diameters of a single puncture between punctures. Deep punctures are those which are about as deep as wide. Texture of the surface, *i.e.* smooth or rugulose, refers to the surface of the cuticle between the punctures. Length of hairs is likewise indicated in relation to ocellar width.

Head dimensions. Height is the distance from the apex of the clypeus to the top of the ocular swelling in frontal view (h , Fig. 1). Length is the

approximate distance from the occipital carina to front of the vertex in dorsal view (l, Fig. 5). Width is the maximum width of the head including the eyes (w, Fig. 1).

Ocelli. Distances between the lateral ocellus and the eye (eo, Fig. 5) and the occipital carina (co) are given in proportion to the distance between the inner margins of the lateral ocelli (oo).

Gena. Width of the gena is the distance between the margin of the eye and the occipital carina at the various points indicated. The postgenal convexity is the convexity of the lower third of the postgena, seen on the gena as a more or less developed convexity of the ventral portion of the posterior margin (pg c, Fig. 47).

Clypeus. Width of the clypeus is measured between the mesal margins of the mandibular condyles (cw, Fig. 1). Length is the distance between the apex and the median point of the epistomal suture. The contact with the eye is the distance from the point of contact of the epistomal suture to the ventral curvature of the eye (c, Fig. 1). The lateral clypeal lobes are the lateral extensions of the distal margin of the clypeus and the apical triangle is the portion of the clypeus set off by a line drawn between the ventral margins of these lobes (ll, tr, Fig. 1).

Malar space. The malar space is the vertical length of the subgena immediately posterior to the first mandibular condyle (m, Fig. 2).

Pronotum. Because of the angular nature of the pronotum, it is necessary to designate a dorsal surface as distinguished from anterior and lateral surfaces. These three surfaces are more or less distinct from each other depending on the development of the pronotal keel and the humeral angle. The humeral angle is the shoulderlike development of the anterolateral surface of the pronotum. (h, Fig. 9), and it may bear the enlarged and anteriorly inflected pronotal keel (k, Fig. 44). In genera such as *Polybia* and *Synoeca* the humeral angle may be entirely absent, the pronotum forming an almost flat oblique surface.

Scutellum. Like the pronotum, the scutellum is more or less angular and may have a distinct horizontal, dorsal surface and a vertical, posterior surface. The lateral surfaces, if likewise distinct, form the variable scutellar pockets (scu p, Fig. 15). If the margins between these surfaces are sharp, the scutellum is said to be angular. If the margins are rounded, the scutellum is termed rounded. The scutellum is bilobed when there is a median, posterior emargination (Fig. 12). The length and width of the respective surfaces is the median measurement unless otherwise indicated (l, w, Fig. 9).

Propodeum. The propodeum is entirely vertical and is divided into posterior and lateral surfaces, corresponding to the dorsal and lateral surfaces of the extended propodeum of the *Polybia*-like genera. The propodeal angle is the lateral development of the propodeum (pr a, Fig. 13) and is not to be

confused with a compressed lobe (pr 1) which is often present on the propodeal angle which is actually an extreme development of the lateral ridge (lr).

Abdomen. The term abdomen is here used to designate the gaster or metasoma. Metasomal segments are numbered with Arabic numerals whereas the true abdominal segments are designated by Roman numerals (*i.e.*, tergum 2 = tergum III). Arabic numerals are used throughout the species treatments. The length and width of a tergum are the maximum median measurements.

Genitalia. Terminology here follows that of Snodgrass (1941). The volsella consists of a large digitus (= tenette of Buysson) which articulates with the volsellar plate, and a small cuspis (= volsella of Buysson) which is appressed against the mesal margin of the paramere (cu, Fig. 17). The digitus bears a distal lobe of variable shape (dl, Fig. 17). The posterior angle of the digital lobe is the form of the apex of the lobe, and the ventral angle is the form of the ventral process of the lobe (pa, va, Fig. 18). The volsellar lobe (= appendice of Buysson) is here used to designate the fingerlike lobe arising proximal to the digitus (vl, Fig. 17), which seems to be unique among the Polybiinae. Araujo (1946) has figured *Protonectarina* as having a small volsellar lobe but to my knowledge no other polybiine has this structure.

TAXONOMIC CHARACTERS

It is unfortunate that in taxonomy the most obvious and attractive characters are often emphasized and receive unjustified weight over other, more subtle characters, whether or not they merit such treatment. Such has often been the case in the taxonomy of *Brachygastra* and of the social Vespidae in general. Color, because of its predominant effect on the appearance of the wasp, has received considerable attention. Many species have been described on the basis of color alone and numerous "varieties" or "color forms" have been designated without indication whether the form was a geographical variant, a local color form or a subspecies. Consequently the treatment of the numerous forms varies, resulting in taxonomic and nomenclatorial confusion. I am by no means condemning the use of color as a character in the Vespidae, but rather the emphasis on color characters without prior consideration of the stability of the character both within populations and throughout the ranges of species.

It has been shown (Enteman, 1904) that color pattern in *Polistes* may be correlated, at least in part, with environmental conditions. Richards and Richards (1951) found the extent of the yellow color pattern in *Brachygastra scutellaris* to be correlated with ovarial development. At least one described form, *Nectarinia rufiventris* Saussure, may be based on a teneral specimen. The occurrence of yellow forms in both *Brachygastra scutellaris* and *B.*

bilineolata in the dry savannas of northern South America, and the predominance of black pigmentation in other species of *Brachygastra* found in high altitudes also suggests that environment has an effect on pigmentation, although there are doubtless genetic components involved.

I question the value of naming varieties when these are merely variations within a population. For the most part the long lists of varieties in species such as *Polistes canadensis* (Linnaeus) and *Brachygastra scutellaris* (Fabricius) are unnecessary and cumbersome. Some of the varieties may be distinct species, as has been found in both *Polistes* and *Brachygastra*, but a large number are probably only color forms and hence need not and should not be given names.

The present classification is based on more stable characters such as the occipital carina, pronotum, scutellum, metanotum and propodeum. The cuticular structures such as punctures and hairs are also used but color pattern is considered only on a qualitative basis.

The best characters are found in the male genitalia but unfortunately the males are seldom collected and in some species are entirely unknown. It is on the basis of male characters that *B. mellifica* (Say) and *B. smithii* (Saussure) have been recognized in this study. Variation among the females of some species indicates the possibility of their separation into additional species, but too little is known to justify such separation at present.

This study of the genus, then, cannot be considered a complete and satisfactory treatment, but rather a reevaluation on the basis of the material available.

Brachygastra Perty

- Brachygastra* Perty, 1833, Delectus Anim. Articul. Brasil, p. 145. (Type species, *Brachygastra analis* Perty = *Polistes lecheguana* Latreille; designated by Bequaert, 1932).
Nectarina Swainson and Shuckard, 1840, On the History and Natural Arrangement of Insects, p. 183, foot note. (Type species, *Brachygastra analis* Perty = *Polistes lecheguana* Latreille; designated by Ashmead, 1902) (New name for *Brachygastra* Perty, 1833).
Melissaia Shuckard, 1841, in White, Ann. Mag. Nat. Hist. 8:320, foot note (new name for *Nectarina* Swainson and Shuckard, 1840).
Brachygaster Saussure, 1852, Et. Fam. Vesp. 1:171, foot note (misspelling of *Brachygastra* Perty, 1833). Not *Brachygaster* Leach, 1817 (Hym.).
Nectarinia Saussure, 1853-1858, Et. Fam. Vesp. 2:225 (misspelling of *Nectarina* Swainson and Shuckard, 1840). Not *Nectarinia* Illiger, 1811 (Aves).
Caba R. von Ihering, 1904, Rev. Mus. Paulista 6:105. (New name for *Nectarinia* Saussure, 1853-1858).

The genus *Brachygastra*, as first proposed by Perty in 1833, included two species, *B. analis* Perty and *B. scutellaris* Perty. Perty's name, *Brachygastra*, was subsequently replaced with *Nectarina* by Swainson and Shuckard who considered it a homonym of *Brachygaster* Leach, 1817. In proposing the new name they inadvertently created a homonym of *Nectarinia* Illiger, 1811, a genus of Sunbirds (Nectariniidae). Consequently Shuckard the following year changed the name to *Melissaia*. Saussure in his monograph used the name *Nectarinia*, and included ten species in the genus. At the same time

Smith (1857) used, once again, the name *Nectarina* and both names were used until Bequaert (1932) recognized *Brachygastra*. R. von Ihering had attempted to solve the nomenclatorial problem by proposing the name *Caba* to replace *Nectarinia* but his name was not widely used due to the general acceptance of *Nectarina*. As late as 1932, *Nectarina* was used in preference to *Brachygastra* even though the validity of the latter name was recognized.

DIAGNOSIS. *Brachygastra* is easily recognized by the prominent, projecting scutellum which, together with the metanotum and propodeum, forms the flat, vertical posterior surface of the thorax (Fig. 13). The first abdominal segment is short, cap-shaped, and not at all petiolate. The second segment is greatly enlarged, and often conceals the succeeding segments, giving the wasps their characteristic, short form (Fig. 68). Several polybiine genera such as *Pseudochartergus*, *Chartergus* and *Parachartergus* are quite similar to *Brachygastra* in general appearance but differ on the basis of the above characters as well as the more obvious generic characters such as mouthparts.

FEMALE. Length (h + th + terg 2) 5.9 mm. Wing length 5.9 mm.

Head (Figs. 1, 2, 5). In frontal view little broader than high, rounded, only slightly narrower ventrally than dorsally; in dorsal view 2.5-3 times as wide as long, posterior margin more or less curved. Ocelli normal. Vertex more or less convex, with median ocular convexity more or less developed. Frons slightly convex, interantennal convexity variable, slight. Clypeus 1.4 to 1.8 times as wide as long, more or less convex, distal margin variable, broadly rounded to pointed; epistomal suture evenly curved or V-shaped dorsally. Anterior tentorial pit deep; immediately below antennal socket. Subantennal suture not visible. Malar space very small to about .8 width of antennal socket. Eye moderately emarginate, more or less pubescent. Gena variable, .7 to 1.4 times as wide as eye in lateral view, often with large postgenal convexity, more or less distinct from postgena. Occipital carina variable, very low, incomplete (Fig. 2), to very high, complete (Fig. 47); never absent. Postgena with large lateral sulcus. Labrum small, retracted, concealed under clypeus, tab-like, lightly sclerotized. Maxilla (Fig. 8) with cardo and stipes sclerotized; lacinia lobe-like, almost entirely membranous, with only elongate median area lightly sclerotized; galea sclerotized, subdivided distally; palpus normal, 6-segmented. Labium (Fig. 6) with prementum strongly convex, heavily sclerotized, with long narrow median emargination distally; anterior and posterior lingual plates membranous or very lightly sclerotized; glossae broad, rounded, fused in basal two thirds; paraglossae narrow; acroglossal buttons present, well sclerotized; palpus 4-segmented. Mandible (Fig. 1) with 5 teeth, apical 3 large, acute, basal 2 low, rounded; with two blunt teeth on posterior surface. Antenna with scape about .5 as long as flagellum, slightly curved; pedicel about as long as

wide, swollen; flagellum more or less swollen, basal flagellomere about as long as succeeding two flagellomeres.

Thorax (Figs. 9, 13, 15). Cuboid, about as long as high; posterior surface flat, nearly parallel with anterior surface. Pronotum variable, rounded to angular; humeral angle absent to well developed; pronotal keel variable. Scutum wider than long. Scutellum strongly convex, prominent, rounded to angular, often extending over plane of metanotum; axilla large, vertical, formed into a ridge dorsally; scutellar crest forming an elongate, flattened, blade-like flange. Metanotum flat; dorsal and ventral margins more or less parallel; metanotal depression large, deep. Mesopleuron strongly convex, entire, not subdivided by any suture. Metapleuron divided into a small dorsal sclerite and a larger, broader, ventral sclerite; secondary suture indistinct; first metapleural pit present, second pit absent. Propodeum sharply truncate, rounded to angular, forming together with the scutellum and metanotum, the flat posterior surface of thorax; propodeal angles rounded to greatly developed laterally; apical scales small, angular, forming a right angle in lateral view; orifice oval. Coxae and trochanters normal. Femora with weakly developed basal ring. Tibia 1 with one long, narrow, blade-like spur bent medially. Tibia 2 with two normal spurs. Tibia 3 with one large blade-like spur and one normal spur. Basitarsus 1 and 2 little shorter than succeeding tarsomeres; basitarsus 3 longer than succeeding tarsomeres; tarsomeres symmetrical. Wings extending beyond apex of abdomen. Basal vein ending at base of stigma, second cubital cell much higher than wide; third cubital cell much wider posteriorly than anteriorly. Hind wing with cross-vein cu-a almost parallel with $M + Cu_1$ apically; vein 1A distinct from cu-a, extended somewhat beyond cu-a. Hamuli 6 to 9.

Abdomen. Spheroid, often wider than long; as wide or wider than thorax; pedicel very short. Segment II very small, cap-shaped, often flattened onto segment III; sternum II reduced, much wider than long. Segment III very large, considerably wider than long; either flattened anteriorly and abruptly curved in profile or evenly rounded. Succeeding 3 segments often retracted into segment III, very short, about 3 times as wide as long. Tergum and sternum VII rounded apically. Sting with lateral serrate margins apically.

Coloration. Very variable, ranging from entirely black to almost entirely yellow (Figs. 68, 69).

Pubescence. Variable, from very sparse and short to dense and long.

MALE. As in female except for following:

Head (Figs. 3, 4, 7). Vertex more convex. Gena much narrower than eye in lateral view. Clypeus longer, less convex. Anterior tentorial pits far

below antennal sockets. Subantennal suture present. Antenna with scape relatively shorter, about .2 as long as flagellum; basal flagellomere shorter than succeeding two flagellomeres.

Thorax. Pronotum, scutellum, and propodeum more rounded than in female.

Abdomen. Apex of tergum VIII and sternum VIII + IX broadly rounded; spiculum variable; apodeme of sternum VIII broad, rounded.

Genitalia (Figs. 17, 18). Basal ring curved caudad medially. Paramere 2 to 3 times as long as high, more or less truncate apically, bearing a long parameral spine which arises from inflection of dorsal margin of paramere; ventral, mesal margin with variable emargination at base of volsellar plate and at base of paramere. Volsellar plate bearing variable, fingerlike volsellar lobe. Cuspis appressed against mesal surface of paramere. Digitus short, thick set, with large distal lobe; lobe variable. Aedeagus with variable distal lobe formed by ventrally inflected margins of spatha; apex of lobe membranous; lobe open ventrally; spatha variable; ventral hook more or less developed; aedeagal apodeme large, variable, terminating at ventral hook.

Coloration. Males are more extensively marked with yellow than females.

KEY TO THE SPECIES OF *Brachygastra*

1. Females: Antenna with 10 flagellomeres. Gena about as wide as or wider than eye in lateral view 2
 Males: Antenna with 11 flagellomeres. Gena much narrower than eye in lateral view 18
2. Height of occipital carina on ventral half of gena greater than height on dorsal half (Fig. 47) 3
 Height of occipital carina on ventral half of gena equal to or less than height on dorsal half (Fig. 2) 8
3. Scutellum rounded in profile; posterior surface not distinct from dorsal surface. Metanotum with median, dorsal, pointed projection (Fig. 65) (western South America) *baccalaurea*
 Scutellum angular in profile; posterior surface distinct from dorsal surface. Metanotum without median dorsal projection 4
4. Heavily punctured; scutum with medium to large sized punctures separated by about one diameter or less medially 5
 Not so heavily punctured; scutum with small to large sized punctures separated by two to three diameters or widely spaced medially 6
5. Propodeal angle greatly developed, strongly projecting laterally; distance from spiracle to apex of propodeal angle about equal to distance from apex of angle to apical scales of propodeum (Fig. 66) (Amazon Basin) *buyssoni*
 Propodeal angle not greatly developed, not strongly projecting laterally; distance from spiracle to apex of propodeal angle considerably less

- than distance from apex of angle to apical scales (Central and South America) *smithii*
6. Scutum with large punctures separated by two to three diameters medially. Surface finely rugulose, not shiny 7
 Scutum with scattered small to medium sized punctures widely spaced medially. Surface smooth, shiny (southern Brazil and southwestern Amazon Basin) *bilineolata*
7. Yellow markings often extensive on propodeum. Scutal lines strongly narrowed or interrupted medially (southwestern Amazon Basin) *propodealis*
 Yellow markings never extensive on propodeum. Scutal lines of even width, never interrupted medially (Central America) *smithii*
8. Scutellum angular; dorsal surface flat or slightly convex; margin between dorsal and lateral surfaces angular (Figs. 9, 14) 15
 Scutellum rounded; dorsal surface moderately to strongly convex; margin between dorsal and lateral surfaces rounded (Figs. 25, 26) 9
9. Pronotal keel well developed 10
 Pronotal keel absent (Mexico) *azteca*
10. Pronotal keel extending onto lateral surface of pronotum as an acute or rounded ridge (Fig. 62) 13
 Pronotal keel absent or indistinct on lateral surface of pronotum (Fig. 40) 11
11. Abdomen with very large punctures separated by one diameter or less. Surface of tergum 2 rugose, dull. Tergum 2 little wider than long (Fig. 69) 12
 Abdomen with small punctures separated by about two diameters. Surface of tergum 2 smooth, shiny. Tergum 2 distinctly wider than long (Central and South America) *augusti*
12. Posterior surface of scutellum low, about 7 times as wide as height at middle (Fig. 34); surface irregularly concave (southern Brazil) *fistulosa*
 Posterior surface of scutellum higher, about 4 times as wide as height at middle (Fig. 42); surface flat (Central and South America) *scutellaris*
13. Abdomen with small punctures. Surface of tergum 2 smooth. Tergum 2 much wider than long 14
 Abdomen with very large punctures separated by one diameter or less. Surface of tergum 2 rugose. Tergum 2 little wider than long (Fig. 69) (Central and South America) *scutellaris*
14. Dorsal surface of scutellum distinctly sloping dorsad, scutellum projecting as high as surface of scutum or above (Fig. 58). Axillar ridges strongly swollen, almost spheroid. Surface of tergum 2 dull, with small punctures separated by about one diameter (central South America) *smithii*
 Dorsal surface of scutellum not distinctly sloping dorsad, scutellum not projecting as high as surface of scutum (Fig. 53). Axillar ridges

- moderately swollen, ovoid. Surface of tergum 2 shiny, with very small punctures separated by about two to three diameters (northern South America and Trinidad) *bilineolata*
15. In dorsal view posterior margin of scutellum distinctly emarginate, V-shaped, lateral length of scutellum as much as 1.2 times as long as median length (Fig. 12); in lateral view distinctly projecting over plane of metanotum (Figs. 14, 15). (Panama and South America) *lecheguana*
In dorsal view posterior margin of scutellum straight to slightly curved or V-shaped; in lateral view only slightly projecting over the plane of the metanotum 16
16. Heavily punctured; metanotum rugose, with irregular punctures, convex (Fig. 11). Hairs on vertex at least two times as long as width of ocellus. Yellow markings much reduced or lacking (southern Andes) *borellii*
Not so heavily punctured; metanotum smooth, punctures, when present, restricted to dorsal margin; metanotum flat. Hairs on vertex about as long as width of ocellus. Yellow markings always present 17
17. *South America *lecheguana*
Mexico and Central America *mellifica*
18. Spatha abruptly expanded between ventral hooks and aedeagal lobe (Fig. 55) 19
Spatha not expanded between ventral hooks and aedeagal lobe (Fig. 17) 21
19. In ventral view aedeagal lobe present, distinctly wider than median width of spatha 20
In ventral view aedeagal lobe not visible, apex of aedeagus not at all widened (Fig. 29) *azteca*
20. In ventral view digital lobe extending beyond apex of cuspis (Fig. 55).
Aedeagal lobe evenly rounded *bilineolata*
In ventral view digital lobe not extending to apex of cuspis (Fig. 63).
Aedeagal lobe moderately tapered to a rounded apex *smithii*
21. Aedeagal lobe narrowed at base 22
Aedeagal lobe distinctly wider at base than at apex (Fig. 37) *augusti*
22. In lateral view apex of digital lobe blunt, forming a right angle (Figs. 18, 21) *lecheguana*
In lateral view apex of digital lobe produced into a long pointed projection (Fig. 24) *mellifica*

SPECIES ACCOUNTS

Most of the species of the genus can be placed in either of two species groups, the *smithii* group or the *lecheguana* group, but four species, *azteca*, *augusti*, *fistulosa*, and *scutellaris* cannot be placed in either of these groups and are here placed in an undefined group.

* Because of the lack of reliable diagnostic characters in these species, locality is used here. See the discussion of variation in these species below.

Brachygastra augusti is similar to the lecheguana group in its color pattern, but has the large pronotal keel like *scutellaris*. *B. scutellaris* has a color pattern similar to that of the *smithii* group, but is morphologically quite distinct. *B. fistulosa* is intermediate between *scutellaris* and *augusti*. *B. azteca* is like the former species on the basis of the rounded propodeum and the punctuation, but is unlike all other species in the absence of the pronotal keel.

***Brachygastra azteca* (Saussure) new combination**
(Figs. 25-30, 33)

Nectarinia azteca Saussure, 1857. Rev. Mag. Zool. 9:280 (♀, Cuautla, Morelos, Mexico; lectotype in Musée National d'Histoire Naturelle, Paris, by present designation).

Nectarinia azteca; Dalla Torre, 1904. Gen. Insect., fasc. 19:86.

Chartergus mexicanus Cameron, 1906. Invertebrata Pacifica 1:154 [♀, Santiago de las Vegas; in the British Museum (Natural History)].

This small species is restricted to Mexico, where it is common in the southern and western states. *Brachygastra azteca* resembles *scutellaris* both in size and general body form. Like *scutellaris*, *azteca* has a distinctly rounded scutellum and propodeum and heavily punctured abdominal segments. It differs from *scutellaris* and other species of the genus, however, by the rounded pronotum which has neither a well developed pronotal keel nor a prominent humeral angle. The pronotum could be said to resemble that found in *baccalaurea* but the latter species never loses the keel entirely as in *azteca*. This species can be best recognized by the rounded abdomen which lacks the flattened dorsolateral surfaces and the abruptly convex anterior surface found in many of the other species. In addition, the first abdominal segment is distinctly narrower than the second giving the abdomen a petiolate appearance. The second tergite bears a wide, yellow, apical band which has two anterolateral emarginations. This band, unlike that of other species is quite stable and perhaps is the best single character for easy recognition of the species.

FEMALE. (1.) Wing length $5.93 \pm .247$ mm.

Head. (2.) In frontal view .87 times as high as wide; in dorsal view .36 times as long as wide; posterior margin strongly curved. (3.) Lateral ocellus separated from eye by about 1.41 times distance between lateral ocelli and from occipital carina by about 1.14 times this distance; punctures dense, medium sized, separated by one diameter or less, often contiguous; vertex very strongly convex, posterior surface sloping strongly ventrad in profile. (4.) In lateral view gena about .75 times as wide as eye at middle; postgenal convexity slight; gena about 0.9 times as wide at level of eye emargination as at level of convexity; punctures medium sized, unevenly spaced dorsally, separated by one diameter or less, often forming long rows, smaller, more scattered ventrally. (5.) Occipital carina low, acute, uniform in height, extending to middle of postgenal convexity. (6.) Frons with large, deep, punc-

tures, evenly spaced, separated by about one half diameter, often contiguous. (7.) Clypeus about 1.7 times as wide as long, moderately convex; distal margin straight, broadly rounded onto lateral lobe; apical triangle about as long as width of antennal socket, apex broadly rounded; epistomal suture forming about a 45° angle with eye margin, dorsally evenly curved; surface smooth, basal 0.7 of clypeus sericeous; punctures very small, sparse. (8.) Malar space small, less than 0.3 width of antennal socket. (9.) Antenna with flagellum strongly swollen, eighth flagellomere about 2.2 times as wide as long. (10.) Head with abundant, short, erect, white hairs slightly less than width of ocellus in length, slightly longer on vertex; eyes with dense short erect hairs; head very lightly sericeous.

Thorax. (11.) Anterior surface of pronotum with scattered small to medium sized punctures dorsolaterally, very small or absent medially; anterior surface not distinctly separated from dorsal surface, in profile rounded onto dorsal surface, not forming a distinct angle with dorsal surface; pronotal keel absent; humeral angle rounded, forming a low, blunt, prominence; dorsal surface evenly rounded onto lateral surface, with deep, medium sized punctures contiguous or nearly so dorsally, smaller and more scattered laterally; lateral surface very wide, with medium sized punctures separated by about one diameter; pronotal lobe distinct, wide. (12.) Scutum about .85 times as long as wide; punctures medium to large, separated by one diameter or less, often contiguous. (13.) In dorsal view scutellum about 3 times as wide as long, posterior margin straight; in posterior view about 3 times as wide as high, dorsal margin straight; in profile evenly rounded, low, not prominent; dorsal surface evenly convex, anterior margin of convexity with small median emargination, dorsal surface rounded onto slightly flattened posterior surface; scutellar pocket well developed, concave, smooth; dorsal surface with medium sized punctures separated by one diameter or less extending onto dorsal portion of posterior surface; axillar ridges prominent, not greatly swollen, with few small punctures. (14.) Metanotum about 2.6 times as wide as long, slightly concave medially; dorsal margin evenly bowed dorsad, forming a slight lip medially; ventral margin very slightly V-shaped; surface smooth with few fine punctures laterally. (15.) Mesopleuron strongly convex; anterior and posterior surfaces with scattered, small punctures; punctures contiguous, medium sized dorsally, slightly smaller, separated by two diameters or less, ventrally. (16.) Dorsal sclerite of metapleuron about twice as high as wide at middle with scattered small punctures; secondary suture indistinct; first metapleural pit small, shallow; ventral sclerite smooth; metapleural-propodeal suture evident as distinct furrow. (17.) Propodeum rounded, swollen; posterior surface with distinct, narrow deep, median concavity, surface rugulose medially, heavily rugose or punctured dorsolaterally; lateral surface with large punctures or rugose sculpturing posteriorly, small

irregular punctures anteriorly; lateral ridge low, indistinct, irregular; propodeal angle not well developed, swollen, rounded in lateral and posterior views, occasionally forming rounded obtuse angle. (18.) Thorax with short white hairs in punctured areas, longer on propodeum than elsewhere; thorax lightly sericeous.

Abdomen. (19.) Tergum 1 cap-shaped, distinct from tergum 2; about 3.5 times as wide as long in dorsal view; sternum 1 about 3 times as wide as long; tergum 1 with scattered small punctures, sternum finely rugulose. (20.) Tergum 2 about .85 times as long as wide, low, evenly convex in profile, with deep, medium to large sized punctures separated by two diameters or less, fewer and smaller anteriorly; sternum 2 with punctures as on tergum. (21.) Terga and sterna 3-5 with deep, medium sized punctures separated by one to two diameters. Tergum and sternum 6 with few fine punctures. (22.) Abdomen with sparse, short, white hairs.

Coloration. Black with yellow markings as follows: Two small inter-antennal spots; apex of clypeus; lower half of inner orbit; band on ridge of pronotum; posterior apices of pronotum; two posterolateral scutellar spots; dorsal and lateral margins of metanotum; apical band of tergum 1; broad apical band with small, lateral, anterior emarginations on terga and sterna 2-6. Flagellum slightly fulvous ventrally. Apex of clypeus and mandible, coxae and legs dark brown to ferruginous.

MALE. (1.) Wing length $5.89 \pm .577$ mm.

As in female except for following:

Head. (2.) In frontal view about .85 times as high as wide; in dorsal view about .32 times as long as wide. (3.) Lateral ocellus separated from eye by .93 times distance between lateral ocelli and from occipital carina by .87 times this distance. (4.) Gena about .3 times as wide as eye in lateral view; postgenal convexity lacking; punctures medium sized on entire surface of gena. (7.) Clypeus about 1.34 times as wide as long; slightly convex; distal margin straight; contact with eye about twice width of antennal socket; epistomal suture forming about a 30° angle with eye; apical triangle about as long as width of antennal socket; clypeus entirely sericeous. (8.) Malar space very short. (9.) Scape about .6 width of clypeus; flagellum moderately swollen, eighth flagellomere 1.7 times as long as wide. (10.) Head heavily sericeous.

Thorax. (13.) Dorsal surface of scutellum strongly convex, anterior margin of convexity higher than posterior margin.

Abdomen. (24.) Spiculum long, narrow, about three times as long as width at base, evenly tapered to a rounded apex.

Genitalia. (25.) Paramere about twice as long as high; apex truncate, rounded; parameral spine long, about half as wide at middle as at basal inflection; paramere with small, shallow notch at base of volsellar plate.

- (26.) Volsellar lobe depressed, in ventral view about .5 times as wide at base as long, extending to middle of digital lobe, evenly tapered to a blunt apex.
- (27.) Cuspis flattened against paramere, pointed in lateral view, with few small black teeth opposite base of digitus. Digitus stout, in lateral view about twice as long as width at base, posterior angle of digital lobe blunt, rounded, anterior angle acute, slightly rounded, directed slightly ventrad; in ventral view posterior angle acute, rounded, with dense, short erect hairs, anterior angle blunt, rounded; mesal surface of lobe with few scattered small punctures; lateral surface with a curved band of small black teeth extending from anterior angle to base of digitus, teeth larger basally than apically.
- (28.) Aedeagus in lateral view slightly curved ventrad, lobe about .45 length of entire spatha, lobe flat, slightly swollen; in ventral view lobe as wide at apex as at base, slightly narrower than middle of spatha, with ventral inflected margins parallel on basal 0.5 of lobe, meeting at middle; spatha abruptly widened at base of lobe to about 1.6 times width of spatha at middle, with lateral row of small teeth basally; ventral hook long, curved laterad apically; in lateral view aedeagal apodeme wide, slightly angular, widened strongly about 0.3 distance from base to hook, forming blunt right angle ventrally; in dorsal view, compressed.

Coloration. Black with yellow markings more or less developed as follows: two interantennal spots or entire interantennal area; innerorbits extending as far dorsad as eye emargination; apical margin to entire clypeus; ventral surface of scape and occasionally pedicel; pronotal ridge; posterior apices of pronotum; median and lateral spots on scutellum; dorsal margin of metanotum; anterior and posterior spots on tegula; ventral surfaces of coxae and trochanters; apical band on metasomal tergum 1; apical bands on metasomal terga and sterna 2-6, sternal bands with lateral emarginations. Flagellum ferruginous ventrally. Wings clear with dark brown veins.

TYPE MATERIAL. There are three female syntypes in the Musée National d'Histoire Naturelle, Paris, labeled "Nectarinia azteca Sauss., cotype. H. de Saussure det." These are, no doubt, of the original type series but it is possible that they do not represent the entire series. Labels on two of the specimens indicate that Saussure gave them to Sichel in 1867. There are twelve additional specimens in Saussure's collection in Geneva which probably represent the remainder of the specimens he examined in 1857.

Two of the syntypes are labeled "Cuantla, t.c." which probably refers to Cuantla, Morelos. I have designated one of these as lectotype. It has the following labels: "Museum Paris, Mexique, Coll. O. Sichel 1867"; "Cotype!"; "Cuantla, t.c."; "Cotype donné a Sichel par Saussure"; "Nectarinia azteca Sauss., Mexique"; "Nectarinia azteca Sauss., Mexique"; "Nectarinia azteca Sauss., cotype, H. de Saussure det."

VARIATION. The color pattern of *azteca* varies somewhat geographically but never approaches the extremes of variation as found in the South American species. Likewise, in strong contrast to the other species, the variation at any one locality is slight.

Specimens from Sinaloa and Sonora commonly display the fully developed color pattern as described above. There is a gradual decrease in head and thoracic color pattern toward the south, and specimens from Chiapas, the southernmost extremity of the range, have only the inner orbital spots and occasionally a small pronotal spot. Intermediate specimens, i.e., those with orbital spots and a well developed band on the pronotum, are found in Jalisco, Michoacan and Nayarit. The most persistent markings are the orbital spots, which, even though reduced, never disappear, and the abdominal bands, which vary little throughout the range.

DISTRIBUTION. *Brachygastra azteca* is the only species of the genus that is restricted to Mexico. It appears to be restricted to the west coast and south central Mexico.

Specimens have been examined from the following localities. *Chiapas*: 5 mi. E., 28 mi. W. of Cintalapa; Comitán; El Ocotál; 1 mi. S., 2 mi. N. of Suchiapa; 6 mi. N. of Villa Flores. *Chihuahua*: 2 mi. S. of Matáchi. *Colima*: 5 mi. W. of Manzanillo. *Guerrero*: 40 mi. N., 20 mi. E., 9 mi. W. of, and Acapulco; Chilapa; 3 mi. N. 4000 ft., 16 mi. N., 5 mi. S. 2 mi. E. of Chilpancingo; Hacienda de la Imagen 4000 ft.; 1.5 mi. W. Mochitlán; 23 mi. N.E., 19.5 mi. N.E. of, and Taxco; Xalitla 1500 ft. *Guanajuato*: Guanajuato; 25 mi. S.W. Salvatierra. *Jalisco*: Chapala; 18 mi. S. of, and Guadalajara; 15-20 mi. W. of Jiquilpan; Lagos de Moreno, 6400 ft.; 5 mi. S.E. of Plan de Barrancas. *Mexico*: 5 mi. N., 15 mi. S. of, and Ixtapan de la Sal 5500 ft.; 13.5 mi. S.E. of Tenancingo; 6 mi. W. of Zautepéc. *Michoacán*: 11 mi. E. of Apatzingán; Chavinda 5800 ft.; 6 mi. W. of Jacana; 2 mi. S. of Tziztio 4450 ft.; 15 mi. E. of Zamora. *Morelos*: 3 mi. N. 3400 ft., 2 mi. S. 3000 ft. of, and Alpuyecá; Canyon Lobos [4.3 mi. W. Yautepéc]; 4 mi. E. 6000 ft., 3 mi. N.W. Cuernavaca 5500 ft.; Huajintlán 2800 ft.; 6 mi. S.W. Joncatepec 3700 ft.; Lake Tequesquitengo 2800 ft.; Matamoros; Tetecala 3500 ft.; 6 mi. S. Temixco; Tepotztlán; 7 mi. N.W. 4000 ft. of, and Yautepéc. *Nayarit*: Ahuacatlán; San Blas; 6 mi. S. Temixco; 13 mi. S.W. of, and Tepic 3000 ft. *Oaxaca*: 20 mi. E. of El Camarón; 48 mi. S. of Chivela; 7 mi. N.E. of, and Juchitán; 23 mi. S. Matías Romero; 47 mi. S.E. Oaxaca; (Sierra de Pluma); Salina Cruz; 8 mi. N.W. of Tamazulapan 6500 ft.; 64 mi. W., 48 mi. W., 44 mi. W., 14 mi. N.W. 700 ft. of, and Tehuantepec; 12 mi. N.W. Totolapan; Zanatepec. *Puebla*: 11 mi. S.E. of Acatlán; 7 mi. N. of Izúcar de Matamoros 4450 ft.; 2 mi. N.W. Petalcingo 4600 ft.; Tehuacán; 8 mi. S.E. 4100 ft. of, and Tehuiztingo. *Sinaloa*: 13 mi. N., 20 mi. S. 250 ft. of Culiacán; 14 mi. S.E., 8 mi. S.E. of Elota; 16 mi. S. of, and Guamúchil; 1 km. N.W. St. Lucía 3700 ft. *Sonora*: La Aduana; 7 mi. W. of, and Alamos; (Bakachaka) on the Río Mayo; Cócorit; Esperanza; San Bernardo on Río Mayo.

BIOLOGY. Although *B. azteca* is very common in many parts of Mexico, relatively little is known about its biology. According to Buysson (1905), the nests are constructed in shrubs and cacti, but I have seen them in large trees as well. The nest is the spherical phragmocytтарous type of Saussure, i.e., the combs are strongly convex and placed one below the other as in *Polybia*. The communicating passageways in the combs are lateral but are not placed one below the other as is common in most other phragmocytтарous nests. Buysson reported that there may be two or more openings in one comb.

M. L. Diguet collected three nests of *azteca*, the largest of which contained nine combs and was 12 cm. long and 15 cm. wide. One of these nests (Buy-

son, 1905, Pl. 14, fig. 2) had the carton formed into a lateral, tube-shaped entrance at the lowest comb, a structure not found in any other *Brachygastra* and resembling that found in some *Parachartergus* nests.

B. azteca is known to store honey in its nests but the nests are not collected for it as are those of *mellifica*.

I have seen *azteca* as a common visitor on many flowers, especially Leguminosae. It has also been collected on *Asclepias*, *Croton*, *Donnellsmithia* and *Solanum*. It is attracted in large numbers to sweet juices of ripe fruit.

Brachygastra scutellaris (Fabricius)

(Figs. 42-45)

Vespa scutellaris Fabricius, 1804. Syst. Piezat., p. 265 (2 ♀♀, South America; lectotype in Universitetets Zoologiske Museum, Copenhagen, by present designation).

Brachygastra scutellaris Perty, 1833. Delectus Animalium Articul. Brazil., p. 146 (no type or locality given).

Chartergus scutellaris; Möbius, 1856. Abhandl. Naturw. Ver. (Hamburg) 3:143, 144, pl. 15.

Brachygastra scutellata Spinola, 1851. Mem. Acad. Sci. Torino 13:74 (4 ♀♀, Brazil; in the Museo di Zoologia, Torino).

Nectarinia rufiventris Saussure, 1853-1858. Et. Fam. Vesp. 2:226 [♀, Pará, Brasil; in the British Museum (Natural History)].

Nectarinia scutellata; Saussure, 1853-1858. Et. Fam. Vesp. 2:226, 227, 231, 234.

Nectarinia rufiventris; Smith, 1857. Cat. Hymen. Brit. Mus. 5:136.

Nectarinia scutellata var. *rufiventris*; Ducke, 1904. Bol. Mus. Goeldi 4:322.

Caba rufiventris; R. von Ihering, 1904. Rev. Mus. Paulista 6:106, 108-109.

Nectarinia scutellata var. *gribodoi* Buysson, 1905. Ann. Soc. Ent. France 74:549 (♀♀, "Haut Amazone" and Iquitos, Perú).

Nectarinia scutellaris; Ducke, 1905. Rev. Ent. (Caen) 24:11.

Brachygastra scutellaris var. *myersi* Bequaert, 1942. Jour. New York Ent. Soc. 40:308 (♀ holotype and 5 ♀♀ paratypes; Mt. Roraima, British Guiana, ♀ paratype, Cavinás, Río Beni, Bolivia; in the Museum of Comparative Zoology, Harvard).

Brachygastra scutellaris var. *annectens* Bequaert, 1942. Jour. New York Ent. Soc. 50:307 (♀ holotype and ♀ paratype, Muzo, Dept. Boyaca, 900 m, Colombia; in the Museum of Comparative Zoology, Harvard).

Brachygastra scutellaris var. *colombiensis* Bequaert, 1942. Jour. New York Ent. Soc. 50:308 (♀ holotype and 4 ♀♀ paratypes, Restrepo, Dept. Meta, Colombia; in the Museum of Comparative Zoology, Harvard).

Brachygastra scutellaris var. *gribodoi*; Bequaert, 1942. Jour. New York Ent. Soc. 50:307-308.

Brachygastra scutellaris var. *rufiventris*; Bequaert, 1942. Jour. New York Ent. Soc. 50:307.

As is evident in the above list, this species is quite variable throughout its range and five forms or varieties have been described. It is the smallest species of the genus (5-6 mm., h + th + terg 2) and is quite distinct in the very heavily punctured thorax and abdomen, a character which Fabricius recognized in his original description.

The most common form of the species is easily recognized by the brilliant yellow scutellum and metanotum and the pale, narrow, apical bands on the abdominal terga (b, Fig. 69). On the basis of color alone, the darker forms, which occasionally lack maculations entirely, could be confused with *augusti* and *fistulosa* and the lighter forms extensively marked with yellow with *smithii*, *bilineolata* and *propodealis*. *B. scutellaris* is easily distinguished from these species by the following morphological features: the propodeal angles are swollen and rounded as in *azteca* (Fig. 28), the lateral ridge of

the propodeum is weak or absent, the second abdominal segment is only a little wider than long (Fig. 69) and is flattened dorsolaterally, and the abdomen is covered with very large deep punctures giving the cuticle a dull appearance. Hairs are very sparse and in many areas may be lacking entirely.

FEMALE. (1) Wing length $5.07 \pm .852$ mm.

Head. (2.) In frontal view .85 times as high as wide; in dorsal view .45 times as long as wide; posterior margin moderately curved or roundly V-shaped. (3.) Lateral ocellus separated from eye by 1.5 times distance between lateral ocelli and from occipital carina by 1.6 times this distance; vertex with large, deep punctures separated by one diameter or less; vertex flat. (4.) In lateral view gena about 0.8 times as wide as eye at middle; postgenal convexity slight; gena about 1.4 times as wide at level of convexity as at level of eye emargination; punctures large, almost contiguous mediodorsally, smaller, more scattered ventrally, very small at level of convexity. (5.) Occipital carina low, acute dorsally, extending to postgenal convexity, indistinct and rounded on convexity. (6.) Frons with medium sized, deep, punctures separated by about one diameter. (7.) Clypeus about 1.7 times as wide as long; moderately convex; distal margin straight, broadly rounded onto lateral lobe; apical triangle about 1.5 times as long as width of antennal socket, apex narrowly rounded; contact with eye equal to about width of antennal socket; epistomal suture forming about a 60° angle with eye margin, dorsally forming a broad V; surface smooth, shiny, basal 0.5 sericeous, with few fine punctures. (8.) Malar space 0.3 times as long as width of antennal socket. (9.) Antenna with flagellum strongly swollen, eighth flagellomere about twice as wide as long. (10.) Head with very sparse, short, erect, yellow hairs; eyes almost bare, with very short hairs; head lightly sericeous.

Thorax. (11.) Anterior surface of pronotum smooth, without punctures, distinctly separated from dorsal surface; pronotal keel well developed, extending to level of pronotal lobe, keel rounded and high medially, forming strong dorsolateral anterior inflection at humeral angle, becoming broad and rounded ventral to angle, inflection little wider than width of ocellus; humeral angle rounded in dorsal and lateral view, overlapping occipital carina when head is flexed; dorsal surface of pronotum evenly curved onto lateral surface, with large, deep, punctures, contiguous or nearly so; lateral surface very narrow, rugose; pronotal lobe distinct, wide. (12.) Scutum about .75 times as long as wide; punctures large, deep, separated by one diameter or less, often contiguous. (13.) In dorsal view scutellum 3 times as wide as long, slightly bilobed, posterior margin slightly curved medially; in posterior view about 4.5 times as wide as high at middle; in profile dorsal margin not extending over plane of metanotum; dorsal surface evenly, moderately convex, posterior surface flattened, curving gradually onto dorsal

surface; scutellar pocket distinct, concave anteriorly, flattened posteriorly; dorsal surface with medium sized, deep, contiguous punctures; posterior surface with medium sized punctures dorsally; axillar ridge rounded, small, closely associated with scutum. (14.) Metanotum 3 times as wide as long at middle, very slightly concave medially; dorsal margin evenly bowed slightly dorsad, ventral margin slightly curved, almost straight; smooth without punctures. (15.) Mesopleuron strongly convex; anterior and posterior surfaces smooth with few small punctures; punctures large, separated by two diameters or less medially. (16.) Dorsal sclerite of metapleuron about 3.5 times as high as wide at middle, rugose; secondary suture indistinct; first metapleural pit deep, furrow shallow; ventral sclerite smooth, with few scattered small punctures; metapleural-propodeal suture not evident. (17.) Propodeum rounded; posterior surface with small, round, deep, central concavity; concavity smooth, dorsolateral surface of posterior surface with large deep contiguous punctures; lateral surface of propodeum with large, deep, contiguous punctures posteriorly, smaller, scattered anteriorly; lateral ridge rugose, low; propodeal angles rounded in profile; propodeum swollen posterolaterally in caudal view. (18.) Thorax very lightly sericeous, almost bare, with few scattered short erect white hairs, more abundant on posterior surface.

Abdomen. (19.) Tergum 1 cap-shaped, distinctly separate from tergum 2, about 4 times as wide as long in dorsal view; sternum 1 about 5.3 times as wide as long; tergum with scattered small punctures, sternum rugose. (20.) Tergum 2 about .84 times as wide as long; somewhat flattened dorso-laterally; in profile flattened anteriorly, rounded abruptly onto dorsal surface, somewhat constricted apically; punctures large, separated by one diameter or less, with shallow furrows posteriorly; sternum 2 with large punctures separated by about two diameters or less. (21.) Terga 3-6 and sterna 3-5 rugose, with small punctures posteriorly; sternum 6 smooth with few fine punctures distally. (22.) Abdomen bare except for few scattered erect short hairs.

Coloration. Entirely black to black with yellow markings more or less developed as follows: Inner orbits; apical margin of clypeus; dorsal and ventral medial spot on gena; broad V-shaped marking on vertex; dorsal surface of pronotum; tegula; two parallel lateral lines on scutum; scutellum; axillar ridges; subtegular spot on mesopleuron; metanotum; median concavity of posterior surface of pronotum; apical band on tergum 1; entire surface of tergum 2; broad apical bands on terga 3-5 and sterna 2-5. Mandible, flagellum, legs dark brown. Wings black.

MALE. Ducke (1904) mentions the male but to my knowledge it has never been adequately described and I have seen none.

TYPE MATERIAL. Two specimens labeled "V. scutellaris, ex. Amer. mer.-Schmid." in the Schestedt-Tonderlund collection at the Universitetes Zoologiske Museum in Copenhagen bear "Type" labels and are apparently Fabricius' types. One of these has been labelled lectotype by R. M. Bohart (unpublished) and I hereby record this designation.

I have seen paratypes of Bequaert's varieties and found no differences other than color between them and the specimen compared with the Fabrician types.

VARIATION. The structural characters of *B. scutellaris* do not differ markedly geographically. The color pattern is quite variable throughout the range and at many localities. The most common form has a yellow scutellum and metanotum and pale, narrow apical bands on the abdominal segments (= var. *gribodoi* Buysson) (b, Fig. 69). It occurs throughout the range and is the only form I've seen from Perú. A somewhat less common form like the above but with wider abdominal bands (= typical *scutellaris*) is found in Honduras and British Guiana. Specimens in which the yellow on the scutellum and metanotum is more or less reduced and in which abdominal bands are very narrow (= *myersi* Bequaert) are common in British Guiana and also occur in Bolivia, Brazil and Ecuador. Entirely black specimens (= *colombiensis* Bequaert) (a, Fig. 69) have been seen from Colombia (Dept. Meta) and Brazil (Acre and Guaporé). At the opposite extreme are forms almost entirely yellow which have been collected in Colombia (Dept. Boyaca) (d, Fig. 69). This color variation is continuous, and many individuals fall between the situations outlined above. Saussure described *Nectarinia rufiventris* from Brazil on basis of the brown pigmentation of the second tergite. Richards and Richards (1951) have found this to be a condition in which the reddish color of the teneral specimen persists into the adult.

In view of the absence of discrete morphological differences and distinct geographical relationships between the above forms they must be considered one species. Additional information and specimens should clarify the situation. Analysis of many nests populations would add much to the understanding of the species. Richards and Richards have found, in their examination of *scutellaris* nests in British Guiana, that the extent of yellow color was correlated to some extent with ovarial development, *i.e.* caste, but a definite relationship could not be demonstrated without additional nest studies.

DISTRIBUTION. *B. scutellaris* ranges from Honduras to southern Brazil (Rio de Janeiro). Throughout its range it is sympatric with *augusti* and *smithii*, but it does not extend into Paraguay and Argentina. It is found as far west as the Departamento of Cajamarca in northern Perú and extends into the drier regions of northeastern Brazil (Pernambuco).

Specimens have been examined from the following localities: **CENTRAL AMERICA.** *Costa Rica.* Limón Prov.: Guapiles, 200 m. *Honduras.* Tela Jilamo farm. *Panama.* Barro Colorado Island; Cabina; Summit.

SOUTH AMERICA. *Brazil*. Est. Acre: Iquiri. Est. Guanabara: Rio de Janeiro. Est. Guaporé: Porto Velho. Est. Mato Grosso: Chapada; West Border. Est. Pará: Obidos. Est. Pernambuco: Varyea. *British Guiana*. Essequibo Co.: Bartica; Kaieteur, Savanna; Mazaruni Station; Mt. Roraima. *Bolivia*. Dept. Beni: Blancaflor; Cavinás; Huachi; Reyes; Rurrenabaque 175 m. Dept. Cochabamba: Cristal Mayu; Chapera 200 m. Dept. Pando: north of Mapiří River on Río Beni. *Colombia*. Dept. Boyaca: Muzo. Dept. Meta: Restrepo. *Ecuador*. Napo. *French Guiana*. Dept. Guyane; Cayenne; Noveau Chantier; St. Jean du Maroni. *Peru*. Dept. Cuzco: Maracapata; Valle del Río Cusnipata (= ?Cusipata); Santa Isabel. Dept. Huánuco: Monzon Valley; Tingo María; Río Huallaga 670 m. Dept. Junin: Colonia Perené, 18 mi. N.E. La Merced; Satipo, 700 m. Dept. Loreto: Iquitos; Pevas. Dept. Pasco: Río Aguashiri; Cam. del Pichis. *Surinam*. Dist. Marowijne: Albina.

BIOLOGY. The nest of *B. scutellaris* has been described and figured by Moebius (1856, as *Chartergus*), Ducke (1907) and Rau (1933). The nest described by Rudow (1889) is not of *Brachygastra*. The nest is pyriform and has a single, oval, lateral entrance which opens into the space between the lowest comb and the carton. The largest nest that has been described (Richards and Richards, 1951) was 10 cm. long by 7.5 cm. wide and contained 6 combs and 876 wasps. Van der Vecht (label data) found a nest in the initial stages of construction which contained 62 wasps. The fragile envelope often is streaked with white. The cells are relatively shallow, and the pupae extend considerably beyond the cell.

In British Guiana, the species is associated with clearings or open scrubby woodland but I have seen it in virgin rain forest in Costa Rica.

Richards and Richards dissected samples of two nest populations of 863 and 876 wasps. They found these to contain 8% queens and 30% intermediates, and 6.5% queens and 43.5% intermediates, respectively. Intermediates had ovaries "more or less developed" but distinctly intermediate between the condition found in the workers and queens. Both the extent of the yellow pigmentation and the number of hamuli appeared to be correlated with ovarian development. Both nests were in a similar state of development with large numbers of all stages present, and it is possible that the nests are relatively long lived but probably are not perennial as are those of *lecheguana*.

Brachygastra fistulosa new species

(Figs. 31, 32, 34)

Records of *B. augusti* var. *quinta* from southern Brazil refer to this species.

Among specimens of *Brachygastra augusti* from southern Brazil, I found eight that differ distinctly from other examples from the area and from other species in the genus. While differing in head, ocular, and abdominal proportions, an even more striking deviation from typical *augusti* is the abundance of very large punctures on the abdomen which are similar to those found in *scutellaris*. Additional differences in propodeal and scutellar characters were also noted. Although *fistulosa* occurs together with *augusti*, no intermediate conditions of the above characters were noted and I feel certain this is a distinct species.

R. von Ihering's variety, *quinta*, was also described as having "punctuation très intense et très grosse" on the second abdominal tergite, but these punctures are of a distinctly different character being smaller, deeper, and very dense. His specimens from Rio Jurua collected by Garbe in 1902 have been examined and they undoubtedly are distinct from *fistulosa*. His additional reference to specimens of *quinta* from the states of Paraná and São Paulo, however, is probably a reference to *fistulosa*, the only *Brachygastra* "entièrement noir, vu par dessus" that I have seen from those states.

Although *fistulosa* resembles *augusti* very closely, examination of the following characters will serve to distinguish it from the latter as well as from other species in the genus. The scutellum is low but retains a rectangular shape similar to that found in *lechequana*, a much larger wasp. The large punctures on the abdomen resemble only those found in *scutellaris* and give the cuticle of both these wasps a dull appearance. *B. fistulosa* can be distinguished from *scutellaris* by the proportions and shape of the second abdominal tergum. The latter has a relatively longer tergum (Fig. 69), the cross-section of which is roundly triangular, *i.e.* strongly produced dorsally. *B. fistulosa* is entirely black when viewed from above and may resemble melanic forms of the smaller *scutellaris*.

FEMALE HOLOTYPE. (1.) Wing length 6.50 mm.

Head. (2.) In frontal view .86 times as high as wide; in dorsal view .43 times as long as wide; posterior margin slightly curved. (3.) Posterior ocellus separated from eye by 1.59 times distance between posterior ocelli and from occipital carina by 1.41 times this distance; vertex with small to medium sized punctures separated by one diameter or less, often contiguous, punctures widely separated posterolateral to lateral ocellus; vertex strongly convex, posterior surface sloping ventrad in profile. (4.) Gena as wide as eye in lateral view; postgenal convexity wide, low; gena about 1.3 times as wide at level of convexity as at level of eye margination; gena with small to medium sized punctures irregularly spaced, separated by four diameters to contiguous, occasionally forming long rows, only slightly smaller ventrally, much smaller on convexity and along ventral margins. (5.) Occipital carina a low acute ridge of even height extending to the mandibular condyle. (6.) Frons with deep medium sized punctures separated by about one diameter or less, often contiguous. (7.) Clypeus about 1.7 times as wide as long; strongly convex; distal margin curved, broadly rounded onto lateral lobe; apical triangle about as long as width of antennal socket, apex very broadly rounded; contact with eye equal to width of antennal socket; epistomal suture forming an angle of about 70° with eye margin, dorsally indistinct; clypeal surface smooth, shiny, with few scattered small punctures, basal .2 sericeous. (8.) Malar space very small, about .2 times as long as width of antennal socket. (9.) Antenna with flagellum strongly swollen, eighth flagellomere about 2.1 times as wide as

long. (10.) Head with short erect yellow hairs, length on vertex equal to width of anterior ocellus, shorter elsewhere; eyes with moderately dense short hairs about half as long as width of antennal socket; head very lightly sericeous.

Thorax. (11.) Anterior surface of pronotum smooth, without punctures, distinctly separated from dorsal surface by keel; pronotal keel low and rounded medially, high and distinct at humeral angle, indistinct and forming broad blunt ridge below humeral angle; humeral angle rounded, keel inflected cephalad forming a rounded collar-like extension equal to about width of ocellus at midpoint; dorsal surface of pronotum evenly rounded onto lateral surface, with medium sized punctures separated by less than one diameter or contiguous; lateral surface narrow, rugose, with irregular, small punctures; pronotal lobe distinct, wide. (12.) Scutum .83 times as long as wide; punctures medium sized, separated by about two diameters or less, slightly smaller and more scattered posteriorly. (13.) Scutellum angular, very slightly bilobed, 2.85 times as wide as long in dorsal view, in profile forming a low angular projection; dorsal surface slightly convex with large, deep, contiguous punctures, occasionally slightly separated; posterior surface rectangular, low, about ten times as wide as median height, strongly concave laterally, less so medially, smooth, without punctures; margin between dorsal and posterior surface angular, dorsal surface overlapping posterior surface laterally; scutellar pocket absent; lateral surface flat, punctured; axilla forming wide rounded ridge with small, deep punctures. (14.) Metanotum about 3 times as wide as long at middle; surface slightly concave; dorsal margin swollen, forming a rounded ridge, strongly bowed dorsad medially; ventral margin curved very slightly ventrad; surface smooth with few scattered small punctures dorsolaterally. (15.) Mesopleuron strongly convex with large, contiguous punctures dorsally, punctures about equal to size of ocellus dorso-medially, somewhat smaller ventrally, separated by one to two diameters; punctures small on anterior and posterior surfaces. (16.) Dorsal sclerite of metapleuron twice as high as wide, with few scattered small punctures; secondary suture indistinct; ventral sclerite of metapleuron smooth with scattered, very small punctures; first metapleural pit shallow; metapleural-propodeal suture not evident. (17.) Propodeum rounded, not strongly produced laterally; posterior surface with broad, shallow concavity, surface of concavity very finely rugulose without punctures; dorsolateral surface with large, contiguous, shallow punctures forming an irregular sculptured surface; lateral surface with large shallow contiguous punctures posteriorly, smaller, more scattered anteriorly; lateral ridge low, acute, extending from propodeal angle to apical scales with decreasing height; propodeal angle obtuse in lateral and caudal views, bearing small compressed lobe at apex. (18.) Thorax

lightly sericeous, with very short, erect yellow hairs in punctured areas, longer on lateral areas of propodeum.

Abdomen. (19.) Tergum 1 cap-shaped, distinctly set off from tergum 2; 4.3 times as wide as long in dorsal view; sternum 1 about 5 times as wide as long; tergum irregularly rugulose, with few small punctures, sternum rugulose. (20.) Tergum 2 about .79 times as long as wide, with medium to large punctures separated by one diameter or less, smaller posteriorly, more widely spaced medially; punctures with shallow posterior furrow giving oval appearance; sternum 2 with punctures as on tergum but smaller. (21.) Terga and sterna 3-6 with dense small punctures, rugulose; tergum and sternum 6 with few small punctures. (22.) Abdomen lightly sericeous with very small, sparse, erect, yellow hairs.

Coloration. Black with yellow markings as follows: Lateral apical spots on tergum 3; apical bands on terga 4, 5; apex of tergum 6; apical and medial surfaces of sterna 3-5; sternum 6. Apex of mandible, legs, abdomen dark brown. Wings slightly infuscated along costal margin, veins dark brown.

TYPE MATERIAL. Holotype female from Corupá, Est. Santa Catarina, Brazil, A. Maller collector, in the American Museum of Natural History. Paratypes are distributed as follows: three females from Mt. Itatiaya, 700 m, Rio de Janeiro, Brazil, J. F. Zikan collector, in the Instituto Miguel Lillo, Tucumán, Argentina; two females apparently collected by Ducke bearing only the indication "Brazil, 830" and the determination labels "Nectarinia augusti var. quinta R.v.Ih.," in Collections of the Departamento de Zoologia, Secretaria de Agricultura, São Paulo, Brazil; one female, also apparently collected by Ducke bearing simply the label "830" and a determination label, "Caba (Nectarinia) augusti Sauss.," in the U.S. National Museum; and one female from Guarujá, Iha de Santo Amaro, Brazil, collected by G. E. Bryant, in the British Museum.

VARIATION. In the specimens examined, the only character that differed from the condition found in the holotype was the shape of the propodeal angle. The paratypes all had rounded propodeums in which the propodeal angle was indistinct and the lateral ridge scarcely evident.

Differences in size and proportion were also noted. The mean wing length for the sample was 6.20 mm. as opposed to 6.04 for *augusti*.

DISTRIBUTION. All specimens with the precise locality indicated were from southern Brazil including the states of Rio de Janeiro, São Paulo, and Santa Catarina. R. von Ihering's (1904) records of *Caba augusti* var. *quinta* from Minas Gerais and Paraná probably refer to *fistulosa*. The variety *quinta* was described from the upper Amazon and subsequent determinations of it, made on the basis of color alone, often extended the range erroneously.

***Brachygastra augusti* (Saussure)**

(Figs. 35-38, 40, 41)

- Nectarinia augusti* Saussure, 1853-1858. Et. Fam. Vesp. p. 233 (3 ♀♀, "Capit. de Saint-Paul, Rio Grande, Boyaz," Brazil; ♀ lectotype and 2 ♀♀ syntypes in Musée National d'Histoire Naturelle, Paris, by present designation).
- Nectarinia augusti*; Smith, 1857. Cat. Hymen. Brit. Mus. 5:137.
- Nectarinia augusti* var. *quinta* R. von Ihering, 1903. Ann. Soc. Ent. France 72:153 (♀♀, Est. São Paulo, Ourinno, and Rio Jurua, Amazonas, Brazil; ♀ lectotype from Rio Jurua in Dept. de Zoologia, São Paulo, Brazil, by present designation) (in part).
- Nectarinia augusti* var. *quinta*; Dalla Torre, 1904, in Wytzman, Gen. Insect., fasc. 19:86.
- Caba augusti*; R. von Ihering, 1904. Rev. Mus. Paulista 6:106, 107.
- Caba augusti* var. *quinta*; R. von Ihering, 1904. Rev. Mus. Paulista 6:108, pl. 4, fig. 3.
- Chartergus amazonicus* Cameron, 1906. Zeitschr. Hymen. Dipt. 6:380 [♀, "Cararamer-Amazonia"; type in British Museum (Natural History)].
- Nectarinia amazonica*; Meade-Waldo, 1911. Ann. Mag. Nat. Hist. (8)7:111.
- Brachygastra augusti*; Bequaert, 1944. Bull. Mus. Comp. Zool. 94:271-272.
- Brachygastra augusti augusti*; Araújo, 1960. Stud. Ent. (Petropolis) 3:252.

Because of the relative stability of the color pattern of *Brachygastra augusti*, there has been little confusion as to its identity. Only one variety, var. *quinta* R. von Ihering, has been described. Unfortunately the diagnostic characters of this variety are not generally recognized, and specimens of other species have been assigned to it on the basis of color alone, although it is quite distinct morphologically.

Brachygastra augusti very closely resembles *B. lecheguana* and *B. mellifica* in color and general proportions but is considerably smaller (body length about 5 mm.) than the average sized individuals of the latter species. Occasionally specimens of *mellifica* may be as small as *augusti* but these are uncommon. *B. augusti* can be distinguished from all species of the *lecheguana* group by the rounded scutellum and the large anteriorly inflected pronotal keel (Fig. 40), and from species of the *smithii* group by the latter character and the absence of extensive yellow maculations on the head and thorax. It differs from both *azteca* and *scutellaris* by its very wide, lightly punctured, second abdominal tergum.

FEMALE. (1.) Wing length $5.82 \pm .260$ mm.

Head. (2.) In frontal view .88 times as high as wide; in dorsal view .42 times as long as wide; posterior margin very slightly curved. (3.) Lateral ocellus separated from eye by 1.34 times distance between lateral ocelli and from occipital carina by 1.37 times this distance; vertex with large to medium sized punctures contiguous or nearly so posterolaterally, punctures small to medium sized elsewhere, separated by one diameter or less, often contiguous; vertex slightly convex, posterior surface sloping gradually ventrad in profile. (4.) In lateral view gena about as wide as eye in middle; postgenal convexity broad, low, scarcely evident; gena about 1.3 times as wide at level of convexity as at level of eye emargination; punctures small to medium sized, separated by two diameters or less dorsally, occasionally contiguous, more scattered medially to lacking or smaller posteroventrally. (5.) Occipital carina low, acute, of even height, extending to mandibular condyle. (6.)

Frons with small to medium sized punctures, separated by about two diameters, occasionally close. (7.) Clypeus about 1.7 times as wide as long, moderately convex; distal margins curved, broadly rounded onto lateral lobes; apical triangle as long as width of antennal socket, apex broadly rounded; contact with eye equal to width of antennal socket; epistomal suture forming about 60 degree angle with eye margin, dorsally forming a broad V; surface smooth, shiny, with few fine, scattered punctures; basal 0.2 sericeous. (8.) Malar space about 0.3 width of antennal socket. (9.) Antenna with flagellum strongly swollen, eighth flagellomere twice as wide as long. (10.) Head with short, erect, gold hairs, about 0.5 to 0.8 width of ocellus in length; eye with sparse, short, erect hairs; head slightly sericeous.

Thorax. (11.) Anterior surface of pronotum smooth, with few scattered small punctures, distinctly separated from dorsal surface of pronotum; pronotal keel low, indistinct medially, absent laterally below humeral angle, developed into large, collar-like ridge at humeral angle, inflected strongly cephalad; humeral angle rounded in dorsal and lateral view; dorsal surface of pronotum evenly rounded onto narrow lateral surface, with medium to large, deep, contiguous punctures, separated by about one diameter at posterior margin; lateral surface narrow, with scattered large punctures; pronotal lobe wide, distinct. (12.) Scutum about .75 times as long as wide, with medium sized punctures, separated by three diameters or less, occasionally forming rows. (13.) In dorsal view, scutellum about three times as wide as long, moderately bilobed, about .75 as long at middle as at lateral margin, posterior margin forming a flattened V; in posterior view, about five times as wide as high at middle, dorsal margin bilobed; in profile, scutellum rounded, prominent, extending slightly over plane of metanotum; dorsal surface strongly biconvex, rounded laterally, posterior surface slightly concave; scutellar pocket absent; dorsal surface with large contiguous punctures, posterior surface smooth, dorsal punctures only slightly extended onto posterior surface; axillar ridge swollen with small contiguous punctures. (14.) Metanotum about 3 times as wide as long, slightly concave; dorsal margin bowed evenly dorsad, ventral margin slightly V-shaped; surface smooth with scattered, small, punctures. (15.) Mesopleuron very strongly convex; anterior and posterior surfaces with scattered, small punctures; large contiguous punctures dorsally, separated by one diameter or less medially, smaller, more scattered ventrally. (16.) Dorsal sclerite of metapleuron about twice as high as width at middle, with few small punctures; secondary suture indistinct; first metapleural pit deep; ventral sclerite with few scattered small punctures; metapleural-propodeal suture not evident. (17.) Propodeum angular; posterior surface with wide, shallow concavity, median area finely rugulose, without punctures; dorsolateral area with large, contiguous, deep punctures; lateral surface with very large, contiguous punctures posteriorly,

smaller anteriorly, lacking ventrally; posteroventral surface rugose; lateral ridge low, acute, extending from spiracle to apical scale; propodeal angle well developed, forming a rounded right angled lobe in lateral view, an oblique shelf-like ridge in posterior view. (18.) Thorax very lightly sericeous with sparse, short, erect, gold hairs on punctured surfaces, longer on propodeum.

Abdomen. (19.) Tergum 1 flattened onto tergum 2, about 6.5 times as wide as long in dorsal view; sternum 1 little less than 6 times as wide as long; tergum with small punctures, sternum rugulose. (20.) Tergum 2 about .73 times as long as wide, high, abruptly convex in profile; tergum with dense, evenly spaced small punctures separated by about two diameters, slightly larger along lateral margin; sternum 2 with punctures more widely spaced. (21.) Terga and sterna 3-5 with dense small punctures, tergum and sternum 6 with few small punctures. (22.) Abdomen with very short erect hairs; very lightly sericeous.

Coloration. Black with yellow markings more or less developed as follows: ventral spot on inner orbit; two interantennal spots; median line on pronotal keel; dorsal margin of metanotum; apical bands on metasomal terga and sterna 2-6. Wings clear, slightly infuscated basal to stigma, veins brown.

MALE. (1.) Wing length $5.99 \pm .137$ mm.

As in female except for following:

Head. (2.) In frontal view .87 times as high as wide; in dorsal view .37 times as long as wide. (3.) Lateral ocellus separated from eye and from occipital carina by .85 times distance between lateral ocelli. (4.) Gena .43 times as wide as eye in lateral view; postgenal convexity absent; gena only slightly wider ventrally than dorsally. (5.) Occipital carina distinct on dorsal .7 of gena, indistinct ventrally. (7.) Clypeus .73 times as long as wide; slightly convex; distal margin almost straight, apex narrowly rounded; apical triangle about .8 times as long as width of antennal socket; contact with eye equal to about 1.3 times width of antennal socket; epistomal suture forming about a 30° angle with eye margin; clypeus entirely sericeous. (8.) Malar space very short, almost absent. (9.) Scape about 0.6 times width of clypeus; flagellum moderately swollen, eighth flagellomere about 1.9 times as wide as long.

Thorax. (11.) Pronotal keel ending abruptly at humeral angle, forming a low acute ridge across dorsal surface of pronotum, higher at humeral angle. (13.) Metanotum with dorsal surface strongly convex. (17.) Propodeum more rounded.

Abdomen. (24.) Spiculum long, narrow, about 5 times as long as basal width.

Genitalia. (25.) Paramere 2.3 times as long as high; apex truncate, angular ventrally, rounded dorsally; parameral spine about as wide at middle as at basal inflection, with dorsolateral invagination, bispinose in appearance; paramere with small, shallow notch at base of volsellar plate. (26.) Volsellar lobe 0.3 times as wide at base as long, evenly tapered to rounded apex, strongly depressed, extending to middle of digital lobe. (27.) Cuspis of volsella flattened against paramere, apex pointed in lateral view, with few, small black teeth opposite digital lobe. Digitus in lateral view thick-set, about 3 times as long as width at base, posterior angle of digital lobe forming a rounded right angle; in ventral view lobe with strong lateral swelling, posterior angle forming a rounded acute angle; lateral surface of digitus with many small short tubercles. (28.) Aedeagus in lateral view with apical lobe bent ventrad, lobe about 0.3 length of entire spatha, swollen, basally with lateral row of very small teeth; in ventral view lobe about .75 as wide at apex as at base, base about 2 times width of spatha at middle, lobe with lateral margins inflected mesad about 0.3 width of lobe, inflected margins parallel on apical 0.7 of lobe, divergent on basal 0.3; spatha gradually narrowed to point basally; ventral hook long, curved laterad; aedeagal apodeme evenly curved, small ventral swelling about 0.3 distance from base to ventral hook.

Coloration. As in female except yellow better developed, as follows: Inner orbit from eye emargination to epistomal suture; interantennal area; entire clypeus; ventral surface of scape and pedicel; anteroventral surfaces of coxae, trochanters, fore and mid femora. Flagellum ferruginous ventrally.

TYPE MATERIAL. There are three specimens of *Brachygastra augusti* labeled "TYPE" in the Paris Museum. They have the following locality labels: "Museum Paris, Sud de la Capit.^e de Goyaz"; "Museum Paris, Bresil, Rio Grande, G. St. Hilaire"; "Museum Paris, Nord Capit.^e de St. Paul, St. Hilaire." Saussure's locality, "Capit. de Saint-Paul, Rio Grande, Goyaz, Bresil", then, cannot refer to any one of the specimens. Capit.^e (= Capitainerie) probably refers to the state or captaincy at that time and does not represent a precise locality. I have designated the specimen with the Rio Grande label as lectotype because it is in the best condition. It bears a second circular label reading "Capit.^e de Rio Grande." It agrees closely with specimens from Goias and with the foregoing description.

R. von Ihering's variety *quinta* was described from a series of specimens in the Museo Paulista but only four specimens (3 ♀ ♀, 1 ♂) there now can be definitely said to be of his type series. These are from the Rio Jurua, Amazonas, Brazil, 1902, E. Garbe collector. I am designating one of these, a female, as lectotype. Other specimens in the museum labeled "Franca, S. P., Brazil, 1902, O. Dreher collector, could possibly be the São Paulo specimens

which von Ihering mentioned. Three additional specimens labeled Brazil, 830, which I have included in the type series of *B. fistulosa* n. sp., could also have been in his type series.

I have seen a specimen of *B. augusti* from Misiones, Argentina, which has been compared with the type of *Chartergus amazonicus* Cameron, and it leaves no doubt as to the synonymy of the latter species.

DISTRIBUTION. *B. augusti* extends from Costa Rica to southern Brazil. It is common throughout the Amazon basin but is not found in the drier areas of northeastern Brazil and the southern Guianas. In Perú and Colombia it extends into the foothills of the Andes and has been collected as high as 1500 m. The southernmost locality that I have seen is in Santa Catarina, Brazil, but Ducke (1910) records it from Rio Grande do Sul. It occurs in eastern Paraguay but has been collected only in the Province of Misiones in Argentina.

Specimens have been examined from the following localities. **CENTRAL AMERICA.** *Costa Rica.* Cartago Prov.: Turrialba. Heredia Prov.: Puerto Viejo. Limón Prov.: Limón. (Colima; Colimbiana Farm, Santa Clara Prov.). *Panamá.* Canal Zone: Ancón; Balboa; Corozal; Juan Mina Station and Plantation; Panamá; Punta Paitilla; Quebrada Bonita; Red Tank; Sabanas. Colón Prov.: Portobelo. (Tabernilla).

SOUTH AMERICA. *Argentina.* Prov. Misiones: (Bemberg); Iguazú. *Bolivia.* Dept. Beni: Riberalta; Rurrenabaque, 175 m; Santa Elena; Trinidad, Río Pan. Dept. La Paz: Corioco; Yungas. Dept. Pando: Río Mapiquí. Dept. Santa Cruz: Santa Cruz, 500 m. *Brazil.* Est. Acre: Iquiri. Est. Amazonas: Manaus; Obidos; (Pevas); Rio Jurua. Est. Goiás: 24 km. E. Formoso; Jatai, Faz. Cachoeirinha. Est. Mato Grosso: Chapada; (Itapura); Porto Velho, Cicade Branco; (Rio Caraguatá); Utiariti, Rio Papagaio; West Border. Est. Pará: (Anamindena); Santarem; Lower Rio Liberdade. Est. Paraná: Caviuna. Est. São Paulo: Franca; Guarulhos; Itaituba; Itápolis; (Lussavira); Porto Cabral; São Paulo; Santo Amaro Island. *British Guiana.* Berbice Co.: New River, 750 ft. Essequibo Co.: Mt. Roraima; Rio Essequibo, Source. *Colombia.* Dept. Boyaca: Porto Olaya, 100 m; Restrepo, 500 m. Dept. Caldas: 12 m S. Anserma, 1030 m. Dept. Cauca: (Hormiguero); Cauca Valley, 3260 ft.; (Hacienda García); Cauca Valley. Dept. Santander: Landazuri, 500 m; San Vicente de Chucurí. Dept. Tolima: Coyaima, 450 m. Dept. Valle: Cali district; Cauca Valley, 3260 ft.; 40 mi. S. Cali, 1140 m. *Ecuador.* Napo-Pastaza Prov.: Puyo, 2000-2500 ft. *French Guiana.* Dept. Guyane: St. Jean du Maroni. *Paraguay.* Dept. Guaira: Colonia Independencia. *Perú.* Dept. Cajamarca: Jaén. Dept. Huánuco: Tingo María; Monzon Valley; Río Huallaga, 670 m; Yurac, 67 m. E. Tingo María. Dept. Loreto: Divisória; Cordillera Azúl, 1300 m; Iquitos; (Río Charape); (Río Cotuhe); Río Putumayo, near Taona. Dept. Pasco: Iscozazín. Dept. San Martín: San Martín, 1500 ft. *Surinam.* Dist. Sarawacca; Kwakoeqron. Dist. Suriname: Paramaribo; Republiek; (Auca on Suriname River). *Venezuela.* Est. Bolivar: Parai-Tepuí. Est. Carabobo: Puerto Cabello; San Esteban. Est. Yaracuy: Laguna de Aroa, 2000 ft.

VARIATION. In order to gain a thorough understanding of the variation in this species, a large number of males should be examined. The females vary little throughout the range, differing only in punctations and slight differences in the scutellum and propodeum. These differences are continuous at any one locality and cannot be considered geographical variation. R. von Ihering's variety is based on a number of specimens from the Rio Jurua which are heavily punctured, but this condition is found also in São Paulo and Venezuela.

In northern Venezuela there is an interesting variation which differs strikingly from the condition found in all other specimens of *augusti*

studied. This is the development of the ocular swelling into a distinct cone-shaped prominence. Wasps of this type also have smaller punctures on the dorsal surface of the pronotum and somewhat larger punctures on the abdomen. Half of the specimens studied from Venezuela were of this type and occurred together with the typical form. Such specimens may represent a distinct population in Venezuela which should be considered a separate species, but until additional material including males becomes available, I do not feel justified in separating it.

Only four males of *augusti* were available for the present study but these were of two distinct types. Two from Jaén, Dept. Cajamarca, Perú, and Trinidad, Dept. Beni, Bolivia, had elongate volsellar lobes and angular digital lobes, and two from Rio Jurua, Est. Amazonas, Brazil, and Muzo, Dept. Boyaca, Colombia, had the shorter tapered volsellar lobes and the rounded digital lobes as described above. It appears then, that there may be two sibling species separable only on the basis of male characters. These species would be broadly sympatric as the males of both are found in widely separated areas in the western Amazon basin. Here again, only the study of males from other areas throughout the range of *augusti* could clarify the situation and facilitate their separation.

The color of this species varies primarily with respect to the width of the abdominal bands. In Costa Rica and Panamá these are very reduced dorsally and present only on the apical segments. In South America the width of the bands varies throughout the range and is only rarely as wide as in *lecheguana*.

BIOLOGY. The nest of this species has been described by R. von Ihering (1904), Ducke (1910) and Bertoni (1911). It is very similar to small nests of the *Polybia occidentalis* group but is more ovoid and fragile. R. von Ihering described the entrance hole as being a vertical slit, $5 \times 30\text{-}40$ mm. as in *Polybia singularis* Ducke. The nest he described had 7 combs and was 10 cm. high and 13 cm. maximum diameter.

I have seen a small ovoid nest in Costa Rica which had been recently founded by 780 wasps. The nest was 6 cm. high and 8 cm. at its greatest diameter with only 4 combs of shallow, incomplete cells. Oviposition had not begun and the main activity was that of enlarging the nest. It appears that the vertical entrance hole is formed by the excentric passageways between the combs being placed one above the other and all opening to the outside. This is unlike many other phragmocytтарous nests which have only one opening, that of the bottom comb which then serves as an entrance to the entire nest. With the former type, all combs open directly to the outside.

In Costa Rica *B. augusti* is found in the cultivated, wet lowlands where I have seen it visiting flowers of *Lantana* and *Hyptis obtusiflora*. I have not seen it in the dry lowlands or at higher altitudes but it has been collected as high as 1500 m. in the Andes.

The *B. smithii* Group

The species of this group have the following characteristics: occipital carina well developed on ventral half of gena; postgenal convexity present, more or less well developed; pronotal keel prominent, projecting cephalad on humeral angle; scutellum rounded; yellow color pattern variable, often extensive and including maculations on the vertex, gena, scutum, scutellum, metanotum, propodeum, and the discal area of the second abdominal tergum. The nests of this group that have been described are small, ovoid and relatively short lived.

Due to the extensive variation of the color pattern of the species in this group, many species and varieties have been described and treatment of these forms varies throughout the literature. The species recognized here are as follows: *B. baccalaurea* (R. von Ihering) in northern Andean regions; *B. bilineolata* Spinola, Venezuela to southern Brazil; *B. smithii* (Saussure), southern Mexico to southern Brazil; *B. propodealis* Bequaert, southwestern Amazon Basin; *B. buyssoni* (Ducke), central Amazon Basin.

Brachygastra baccalaurea (R. von Ihering) new combination
(Figs. 61, 65)

Nectarinia baccalaurea; R. von Ihering, 1903. Ann. Soc. Ent. France 72:154-155 (no sex or locality given; ♀ lectotype from Perú in Departamento de Zoologia, São Paulo, Brazil).
Nectarinia baccalaurea; Dalla Torre, 1904. in Wytzman, Gen. Insect., fasc. 19:86.
Caba baccalaurea; R. von Ihering, 1904. Rev. Mus. Paulista 4:106, pl. 4, fig. 4.

This extraordinary species, described from Perú, has the greatly developed pubescence that is often characteristic of Hymenoptera from Chile and the Andean regions of western South America. Von Ihering's description correlates perfectly with the one specimen found in the collection at the Departamento de Zoologia, São Paulo.

Both in size and general proportions this species very closely resembles *lecheguana*, as von Ihering pointed out. *B. baccalaurea* is easily distinguished from the latter, however, by its characteristic rounded scutellum and the unusual form of the metanotum which bears a median dorsal projection (Fig. 65). A closer comparison shows the abdomen of *lecheguana* to be relatively wider than *baccalaurea*. Two additional characters, the black wings and the yellow markings, also separate the latter from *lecheguana* but not from other species of the *smithii* group. The long, gold hairs which are abundant on the head and thorax distinguish it from other species with similar coloration.

FEMALE. (1.) Wing length $8.10 \pm .340$ mm.

Head. (2.) In frontal view .85 times as high as wide; in dorsal view .37 times as long as wide; posterior margin strongly curved. (3.) Lateral ocellus separated from eye by 1.6 distance between lateral ocelli and from occipital carina by 1.2 times this distance; vertex with small punctures separated by

one diameter or less; vertex strongly convex, sloping ventrad in profile. (4.) Gena about 1.25 times as wide as eye in lateral view; gena with broad, medium sized postgenal convexity, about 0.5 length of entire gena; gena about 1.3 times as wide at level of convexity as at level of eye emargination; punctures small to medium sized, separated by about three diameters dorsally, slightly smaller and more scattered ventrally, very small or lacking on postgenal convexity. (5.) Occipital carina low, distinct, rounded medially, obscure and irregular on temporal convexity, becoming a high, curved, blade-like ridge on postgenal convexity ending at mandibular condyle. (6.) Frons with dense small punctures separated by one diameter or less. (7.) Clypeus about 1.6 times as wide as long, moderately convex; distal margin straight, narrowly rounded onto lateral lobe; apical triangle about as long as width of antennal socket, apex narrowly rounded; contact with eye equal to 0.5 width of antennal socket; epistomal suture forming about a 60° angle with eye margin, dorsally evenly rounded; clypeal surface smooth, shiny with few scattered fine punctures, basal 0.3 sericeous. (8.) Malar space about 0.8 width of antennal socket. (9.) Antenna with flagellum moderately swollen, eighth flagellomere about 1.6 times as wide as long. (10.) Head with abundant, long, golden hairs recurved distally, lengths equal to three times width of ocellus on vertex and frons, equal to little more than width of ocellus elsewhere; eyes densely pubescent; head densely sericeous.

Thorax. (11.) Anterior surface of pronotum with scattered small to medium sized punctures dorsolaterally, in profile distinctly separated from dorsal and lateral surfaces by pronotal keel; pronotal keel low and rounded medially, forming a low acute ridge dorsolaterally, low or absent immediately below humeral angle, forming acute blade-like ridge ventrolaterally; humeral angle more or less acute, forming a point projecting cephalad; dorsal surface sloping strongly onto lateral surface forming one oblique dorsolateral surface, with shallow, medium to large punctures contiguous or nearly so; posterior pronotal lobe wide, distinct. (12.) Scutum about .82 times as long as wide, evenly covered with small to medium sized punctures separated by two diameters or less. (13.) In dorsal view scutellum about twice as wide as long, low and evenly rounded in all aspects; dorsal surface only slightly flattened, not distinct from posterior surface; scutellar pocket absent; punctures medium sized, contiguous, smaller and not contiguous along posterior margin. (14.) Metanotum about 3.3 times as wide as long, convex; dorsal margin with a large medial projection extending over posterior margin of scutellum in caudal view; punctures small, scattered dorsally. (15.) Mesopleuron strongly convex; anterior and posterior surfaces with scattered small punctures; punctures medium sized medially, separated by one diameter or less, surface rugose dorsomedially. (16.) Dorsal sclerite of metapleuron 2.5 times as high as wide at middle, with scattered small punctures dorsally; secondary

suture distinct; first metapleural pit deep with broad, shallow concavity; ventral sclerite with few small punctures ventrally; metapleural-propodeal suture evident as weak furrow. (17.) Propodeum rounded; posterior surface with wide, shallow concavity, median area rugulose, dorsolateral areas rugose, punctures indistinct; lateral surface, rugose, irregularly sculptured posteriorly, with medium to small, contiguous punctures anteriorly; lateral ridge acute, extending from spiracle to apical scale, decreasing in height gradually posteriorly; propodeal angle bearing an obtuse, rounded, flattened, lobe in profile, a rounded ridge in caudal view. (18.) Thorax with long, golden hairs, recurved distally on punctured and sculptured surfaces; thorax heavily sericeous.

Abdomen. (19.) Tergum 1 convex, distinct from tergum 2, about 4 times as wide as long in dorsal view; sternum 1 about 4 times as wide as length at middle; tergum with scattered small punctures, sternum rugulose. (20.) Tergum 2 about .85 times as long as wide; depressed, low, evenly convex in profile; tergum and sternum 2 with small punctures separated by three diameters or less. (21.) Terga 3-6 and sterna 3-5 rugose with small apical punctures; sternum 6 with scattered small punctures. (22.) Abdomen with long, golden hairs, lightly sericeous.

Coloration. Black with yellow markings more or less developed as follows: inner orbit from epistomal suture to eye emargination; oblique line lateral to ocelli forming flattened V pointing posteriorly; dorsal portion of pronotal keel; two parallel, longitudinal scutal lines; axilla; anterior margin of scutellum; dorsal margin of metanotum; apical bands on terga 1-6 and sterna 1-5, discal band on tergum 2 with lateral or posterior emarginations. Wings infuscated with very dark brown, veins black.

MALE. Not seen. The following characters are extracted from Buysson's (1905) description and figure.

Genitalia. (24.) Apex of paramere blunt, not truncate; parameral spine very wide at base. (25.) Volsellar lobe long, extending beyond middle of digitus, wide, with long tactile hairs mesally. (26.) Digitus thick-set, about as wide at base as distance between apex and ventral angle; in lateral view posterior angle rounded, blunt, ventral angle acute; cuspis rounded apically. (27.) Aedeagus with ventral hook well developed.

Coloration. As in female except yellow markings developed as follows: ventral surface of scape; four spots in place of V on vertex; yellow lacking on scutellum. There is no reason to expect the male to be any less variable than the female. Further collections should include males with color patterns as well developed as or even more extensive than those observed in the female.

TYPE MATERIAL. The type collected by R. von Ihering in 1902 is in the collection of the Departamento de Zoologia, Secretaria de Agricultura, São

Paulo, Brazil (Museu Paulista). It bears no indication other than "Peru 827." There is a small circular blue label followed by a determination label, "Nectarinia baccalaurea, R. v. lh. Ducke rev. 11." It is in good condition. As this is the only specimen in the Museum, I have placed a lectotype label on it. According to Ducke (1910), there is an additional cotype in the Paris Museum but this has not been found.

VARIATION. Even though the number of specimens examined was small, the variation both in morphology and coloration was considerable. Von Ihering's type from Perú has fairly well developed humeral and propodeal angles but this condition is moderate when compared with the one specimen from Bolivia in which these angles, especially the latter, approach the extreme condition found in *buyssoni*. The difference between these two specimens is so striking that it may well warrant the recognition of the Bolivian population as a distinct species but until further material is examined, I do not feel that separation is justified.

Other specimens examined from Perú displayed slight variation in the development of the humeral angle but this was always a reduction of the condition found in the type.

The majority of wasps examined were melanic forms, the yellow being present only as spots on the vertex and metanotum and the usual apical bands on the abdominal segments. A few specimens from Ecuador and Colombia showed a gradation from largely melanic to extensive yellow coloration resembling in pattern that found in other species of the *smithii* group. One wasp from Colombia (Caldas Salento) had very extensive yellow markings including the distal band on the second abdominal segment. Although it was smaller, I could find no substantial morphological differences between it and the Peruvian specimens. I expect that additional collections will show this species to be as variable in color pattern as other species of the *smithii* group, and description of specific and subspecific categories should be done with discretion.

DISTRIBUTION. *B. baccalaurea* seems to be restricted to the uplands of Colombia, Ecuador, Perú and Bolivia. The specimens I have seen are all from altitudes of 1600-1900 meters. The greatly developed pubescence and long wings also suggest that it is a species of high altitudinal ranges.

Specimens have been examined from the following localities: *Bolivia*. Dept. La Paz: Mapi. *Colombia*. Dept. Boyaca: Caldas Salento, 1900 m. *Ecuador*. Prov. Napo-Pastaza: Baeza. Prov. Tungurahua: Baños, 1600-1900 m. *Perú*. Dept. Junin: Huacapistana on Río Tarma, 1800 m.

Brachygastra bilineolata Spinola

(Figs. 51-56, 59, 68)

Brachygastra bilineolata Spinola, 1841. Ann. Soc. Ent. France 10:126 (2 ♀♀, Cayenne, French Guiana; in the Museo di Zoologia, Torino).

Brachygastra dorso-lineata; Spinola, 1841. Ann. Ent. Soc. France 10:123. Clerical error for *Brachygastra bilineolata* Spinola, 1841.

- Nectarinia bilineolata*; Saussure, 1853-1858. Et. Fam. Vesp. 2:226, 228, 231, pl. 34, fig. 2.
Nectarinia bilineata; Saussure, 1853-1858. Et. Fam. Vesp. 2:231. Misspelling of *bilineolata*.
Nectarinia bilineolata; Smith, 1857. Cat. Hymen. Brit. Mus. 5:136.
Nectarinia möbiana Saussure, 1867. Reise der Novara, Zool. 2(1):22 (6 ♀♀ from Surinam).
Nectarina möbiana; Dalla Torre, 1904. in Wytsman, Gen. Insect., fasc. 18:86.
Odynerus antillarum Provancher, 1888. Additions Faune Canada, Hymen., p. 420 (♀, Trinidad).
Caba moebiana; R. von Ihering, 1904. Rev. Mus. Paulista 4:106.
Caba bilineolata; R. von Ihering, 1904. Rev. Mus. Paulista 4:106, 111.
Caba bilineolata var. *fasciata* R. von Ihering, 1904. Rev. Mus. Paulista 4:112 (no sex given, Surinam, Rio Jurua, Amazonas, Brazil).
Nectarina bilineolata var. *moebiana*; Buysson, 1905. Ann. Soc. Ent. France 74:547, 552.
Nectarina bilineolata var. *fasciata*; Ducke, 1905. Bol. Mus. Goeldi 4:663.
Nectarina bilineolata moebiana; Ducke, 1918. Rev. Mus. Paulista 10:327.
Nectarina bilineolata var. *smithii*; Vesey-Fitzgerald, 1938. Trans. Roy. Ent. Soc., London 87:184 (misidentification).
Brachygastra bilineolata var. *antillarum*; Bequaert, 1942. Jour. New York Ent. Soc. 50:304.
Brachygastra bilineolata var. *smithii*; Bequaert, 1942. Jour. New York Ent. Soc. 50:305.
Brachygastra bilineolata var. *surinamensis* Bequaert, 1942. Jour. New York Ent. Soc. 50:306 (♀ holotype, Surinam; in the Museum of Comparative Zoology, Harvard).

Spinola's original description unfortunately was concerned primarily with pubescence and coloration, and his species was consequently restricted to forms with similar color patterns whether or not they differed morphologically. *B. smithii* was described as a separate species by Saussure and was considered as such by Buysson (1905), but Ducke (1907) placed it as a variety of *bilineolata*. Bequaert (1942) added *Odynerus antillarum* Provancher and two new varieties, *surinamensis* and *propodealis*, to the list of varieties of *bilineolata*. This study separates *smithii* and *propodealis* as species distinct on a morphological basis and having a color variation parallel to that of *bilineolata*. References to any of the above forms, therefore, could refer to any one of the three distinct species.

B. bilineolata is about 6 mm. long (h + th + terg 2) and is variously marked with brilliant yellow. In general appearance it is often identical with *smithii* but can be separated by examination of the following characters. In northern South America it is separable on the basis of the occipital carina which is low or absent on the ventral half of the gena. *B. smithii* in the same region has a well developed carina. In the southern part of its range, i.e., south of the Amazon, the occipital carina becomes very high but that of *smithii* is, in contrast, much reduced. This character, then, is inversely related in these two species. The scutellum of *bilineolata* is lower than that of *smithii* and does not project strongly dorsad. *B. bilineolata* also has relatively fewer punctures, giving the cuticle a shiny appearance not found in *smithii*. This latter character will serve to distinguish it from *propodealis* in Bolivia and western Amazonas where all three species are found together.

FEMALE. (1.) Wing length $5.98 \pm .302$ mm.

Head. (2.) In frontal view .87 times as high as wide; in dorsal view .42 times as long as wide; posterior margin slightly curved, almost straight.

(3.) Lateral ocellus separated from eye by 1.24 times distance between lateral

ocelli and from occipital carina by 1.37 times this distance; vertex with small to medium sized punctures separated by about one diameter; vertex slightly convex, posterior surface sloping slightly ventrad in profile. (4.) In lateral view gena about as wide as width of eye at middle; postgenal convexity small, irregularly rounded, ventral margin of convexity straight; gena about 1.4 times as wide at level of convexity as at level of eye; punctures medium sized, separated by one diameter or less dorsally, more scattered ventrally, small or absent on convexity and along ventral margin. (5.) Occipital carina low, acute, of even height, extending almost to mandibular condyle, indistinct immediately posterior to condyle. (6.) Frons with small to medium sized punctures separated by about one diameter. (7.) Clypeus about 1.6 times as wide as long; moderately convex; distal margin straight, broadly rounded onto lateral lobe; apical triangle long, about equal to width of antennal socket, apex broadly rounded; contact with eye equal to about 0.5 times width of antennal socket; epistomal suture forming about a 70° angle with margin of eye, dorsally broadly curved; clypeal surface smooth, shiny, with few small punctures, basal 0.3 sericeous. (8.) Malar space 0.5 width of antennal socket. (9.) Antenna with flagellum moderately swollen, eighth flagellomere 1.7 times as wide as long. (10.) Head with abundant, long, golden hairs, about as long as width of ocellus on vertex, shorter elsewhere; eyes with abundant short hairs, about 0.3 width of ocellus in length; head lightly sericeous.

Thorax. (11.) Anterior surface of pronotum with few scattered punctures, distinctly separated from dorsal surface, forming an obtuse angle with dorsal surface in profile; pronotal keel low, acute, extending almost to ventral extremity of pronotum, only slightly higher at humeral angle than elsewhere; humeral angle not well developed, rounded; dorsal surface evenly curved onto lateral surface, swollen posteriorly, with deep, medium sized punctures, contiguous or nearly so; lateral surface narrow, distinct from anterior surface, with medium sized punctures; pronotal lobe wide, distinct. (12.) Scutum about .75 times as long as wide with large deep punctures separated by about one diameter. (13.) Scutellum rounded; in dorsal view about 3 times as wide as long at middle, moderately bilobed, about 0.8 times as long at middle as at lateral margins, lateral margins rounded, posterior margin curved; in posterior view 4 times as wide as high at middle, lateral margins rounded, dorsal margin strongly indented medially; in profile scutellum rounded, prominent, projecting slightly over plane of metanotum; dorsal surface convex, posterior surface concave; scutellar pocket flat; dorsal surface of scutellum rounded onto lateral surface; scutellar pocket punctured posteriorly; dorsal surface with large, deep contiguous punctures, posterior surface smooth with few punctures dorsally; axillar ridge broadly rounded with small punctures. (14.) Metanotum about 3 times as wide as long,

slightly concave; dorsal margin bowed slightly dorsad, ventral margin bowed slightly ventrad; surface smooth with few fine punctures dorsally. (15.) Mesopleuron strongly convex; anterior and posterior surfaces with scattered, small punctures; punctures medium to large sized medially, separated by about one diameter. (16.) Dorsal sclerite of metapleuron about 2.3 times as high as width at middle with scattered small punctures; secondary suture indistinct; first metapleural pit more or less wide, deep; ventral sclerite with few scattered small punctures; metapleural-propodeal suture scarcely evident, forming a weak furrow. (17.) Propodeum moderately angular; posterior surface with broad, deep, central concavity, median area smooth, dorsolateral area with contiguous, medium sized, deep punctures; lateral surface with contiguous medium to large sized punctures posteriorly, smaller and scattered anteriorly, surface rugose ventrally; lateral ridge low, irregular, extending to apical scales, considerably higher on propodeal angle; propodeal angle well developed, appearing as a rounded obtuse angle laterally, a rounded lateral extension posteriorly. (18.) Thorax with abundant, short, golden hairs on punctured surfaces; lightly sericeous.

Abdomen. (19.) Tergum 1 moderately flattened onto tergum 2, about 5.2 times as long as wide in dorsal view; sternum 1 about 4 times as wide as length at middle; tergum with few fine punctures, sternum rugose with sharp transverse median ridge. (20.) Tergum 2 about .73 times as long as wide, high, abruptly curved in profile; surface shiny with small punctures separated by about two diameters, punctures larger on sternum. (21.) Terga and sterna 3-5 with punctures as on 2; tergum and sternum 6 with few or without punctures. (22.) Abdomen with sparse, short, white hairs directed caudad, lightly sericeous.

Coloration. Very variable (Fig. 68). Black with yellow markings more or less developed as follows: lateral and distal margins of clypeus; inner orbits; interantennal area; two oblique bars and a median anterior spot on vertex; anterior half of gena; dorsal surface of pronotum; tegula; two longitudinal bands joined posteriorly on scutum; scutellum; metanotum; subtegular spot on mesopleuron; apical bands on terga 1-5 and sterna 2-5; tergum 2 with or without median discal band or entirely yellow; tergum and sternum 6. Apex of mandible, flagellum and legs dark brown. Wings yellow, darkened apically.

MALE. (1.) Wing length 5.8 mm.

As in female except for following:

Head. (2.) In frontal view .86 times as high as wide; in dorsal view .39 times as long as wide. (3.) Lateral ocellus separated from eye by about .84 times distance between lateral ocelli and from occipital carina by .88 times this distance; vertex strongly convex, posterior surface sloping strongly ventrad in profile. (4.) In lateral view gena .42 times as wide as eye at

middle; postgenal convexity absent; gena narrowed dorsally, about 1.5 times as wide at level of convexity as at level of eye emargination. (5.) Occipital carina low, rounded dorsally, somewhat higher and acute laterally, absent on ventral third of gena. (7.) Clypeus .72 times as long as wide, slightly convex; distal margin curved; apical triangle about as long as width of antennal socket, apex broadly rounded; contact with eye equal to about 1.3 times width of antennal socket; epistomal suture forming about a 30° angle with eye margin; clypeus entirely sericeous. (9.) Antenna with scape about 0.5 times as long as width of clypeus; flagellum moderately swollen, eighth flagellomere 1.5 times as wide as long.

Thorax. (11.) Anterior surface of pronotum evenly curved onto dorsal surface, not distinctly separated from dorsal surface; pronotal keel very low, rounded, indistinct; humeral angle absent; dorsal surface evenly curved onto lateral surface; lateral surface somewhat distinct from anterior surface, with low rounded ridge. (13.) Scutellum strongly convex dorsally; margins rounded; posterior surface with large punctures. (12.) Propodeal angle broadly rounded in lateral view.

Abdomen. (24.) Spiculum long, narrow, about 5.3 times as long as width at base.

Genitalia. (25.) Paramere about 2.1 times as high as wide; apex roundly truncate; parameral spine about 0.8 times as wide at middle as at basal inflection, with slight lateral invagination; without notch at base of volsellar plate. (26.) Volsellar lobe long, wide; in lateral view about 3 times as long as width at base; in ventral view extending little beyond middle of digital lobe, evenly tapered to rounded apex; lobe strongly flattened. (27.) Cuspis appressed against paramere, apex rounded; bearing few teeth opposite base of digitus. In lateral view, digitus thick-set rounded; about 2.3 times as long as width at base, posterior angle broadly rounded, almost reaching apex of aedeagus, ventral angle broadly rounded, directed anteroventrally; in ventral view digital lobe ovoid, greatly widened basally; digitus with small black tubercles laterally. (28.) Aedeagus in lateral view curved ventrad, aedeagal lobe about 0.2 length of entire spatha, lobe strongly swollen; in ventral view lobe rounded, about 1.3 times as wide as width of spatha at middle, inflected margins meeting at apical fourth of lobe, gradually divergent basally; spatha abruptly expanded at base of lobe to about 2 times width of spatha at middle, expansion with row of fine teeth along lateral margin; basal third of spatha with lateral margins gradually convergent to base; ventral hook long, curved laterad apically; aedeagal apodeme angular, widened apically.

Coloration. As in female except for following: yellow markings more extensive as follows: entire surface of clypeus; ventral surface of scape and flagellum; anteroventral surfaces of coxae 1 and 2 and trochanter 1. Flagellum light brown dorsally.

TYPE MATERIAL. Spinola's two female types are in the Museo di Zoologia, Torino. They bear the following labels "Brachygastra bilineolata, m., Ann. Soc. Ent., Cayenne, D. Buquet, M. Leprieur." One of these has lost its head but otherwise they are in good condition. The female with a head is designated lectotype. They both agree closely with the description given above.

I have not been able to locate Saussure's types of *Nectarinia moebiana*, but Buysson indicates that they are in the Natural History Museum at Geneva. There are five specimens labeled *moebiana* in Saussure's collection in Geneva but these do not bear type labels and two are without any labels.

I have also not been able to locate von Ihering's type of var. *fasciata*, and its listing as a synonym of *bilineolata* is on the basis of his original designation. It is quite possible that his types are *smithii* because a specimen determined by him in 1911 as *bilineolata* var. *fasciata* is *smithii*.

VARIATION. The morphological variation present in this species suggests that it may be divisible into two species or at least two subspecies. Specimens from south of the Amazon differ from the above description in the following manner: the occipital carina is high on the postgenal convexity; the scutum has medium sized punctures relatively widely spaced; the scutellum is not as high and is distinctly bilobed, the posterior surface being concave medially; the color variation is not as wide, the scutal lines and discal band being only rarely present. This latter difference is particularly interesting because north of the Amazon the loss of the discal band is not always associated with loss of the scutal lines.

Specimens from Peru and Bolivia agree with those from southern Brazil and specimens from Colombia, Venezuela and Trinidad are like those of the Guianas.

The color variation in *bilineolata*, as noted above, is most striking in the northern part of its range. In Surinam, wasps from the savannas have the entire dorsal surface of the second abdominal tergum yellow (= var. *surinamensis* Bequaert) (d, Fig. 68), but other specimens from northern Surinam often have only the apical band (a, Fig. 68). There does not appear to be a predominance of any one form as many forms are common throughout the range, but at any one specific locality the variation is slight. In Trinidad, for example, all specimens seen had a wide discal band and well developed scutal lines but in the Orinoco delta, south of Trinidad, specimens are very dark with the discal band and scutal lines absent or incomplete.

DISTRIBUTION. *Brachygastra bilineolata*, as treated here, does not extend into Central America but is widespread throughout South America being sympatric with the closely related *smithii*. Ducke (1910) states that it is found only in dry forests and savannas. The extremely yellow specimens (= var. *surinamensis*) from the savannas of the Guianas indicate that it is

found in these drier areas but the color variation throughout the range suggests that it is not restricted to this habitat. In Peru it has been collected as high as 1200 m. (San Ignacio).

Specimens have been examined from the following localities: *Bolivia*. Dept. Beni: Cavinas. Dept. La Paz: Covendo; (Prov. del Sara, 450 m). *Brazil*. Est. Goiás: Jataí. Est. Guaporé: Porto Velho. Est. Mato Grosso: Chapada; (Rio Caraguata). Est. São Paulo: (Eng. Cesar de Souza); (Ilha Seca). Est. Santa Catarina. *British Guiana*. Berbic Co.: Ituni savanna. Demerara Co.: Georgetown; Wismar. Essequibo Co.: Rupununi savanna. *Colombia*. Dept. Meta: Villavicencio. *French Guiana*. Dept. Guyane: Cayenne. *Perú*. Dept. Cajamarca: San Ignacio, 1200 m. Dept. Loreto: Dos de Mayo, El Porvenir. Dept. Pasco: Cam. del Pichis; (Valle Chanchamayo; Río Pampaconas). *Surinam*. Dist. Commewijne: Alliance; Marienburg. Dist. Marowijne: Albina. Dist. Suriname: Blauwgrond; Clevia; Paramaribo; Zanderij savanna. *Trinidad*. Mayaro Bay. *Venezuela*. Est. Anzoategui: Guanta. Est. Bolívar: Ciudad Bolívar. Terr. Delta Amacuro, 140 kms. N.E. Barrancas.

***Brachygastra smithii* (Saussure)**
(Figs. 46-49, 57, 58, 60, 62-64, 67)

Nectarina smithii Saussure, 1853-1858. Et. Fam. Vesp. 2:229, pl. 31, fig. 8 (♀, Santarém, Brazil).

Nectarina smithii; Smith, 1857. Cat. Hymen. Brit. Mus. 5:136, pl. 5, fig. 2.

Caba smithi; R. von Ihering, 1904. Rev. Mus. Paulista 4:106, 112-113.

Nectarina smithi; Dalla Torre, 1904. in Wytzman, Gen. Insect., fasc. 18:86.

Nectarina bilineolata; Ducke, 1904. Bol. Mus. Goeldi 4:322 (in part).

Nectarina bilineolata var. *smithi*; Ducke, 1907. Bol. Mus. Goeldi 5:156, 157.

Nectarina bilineolata smithi; Ducke, 1918. Rev. Mus. Paulista 10:327.

Nectarina bilineolata var. *smithii*; Dover, 1924. Psyche 31(6):307 (in part).

Brachygastra bilineolata var. *smithii*; Bequaert, 1942. Jour. New York Ent. Soc. 50:305 (in part).

Although the type of this species has not been seen, Saussure's description, "Ecusson surplombant, bituberculé, tres grossièrement ponctué," applies well to this species. His description of the color pattern, however, has caused all forms with a median transverse band on the second abdominal tergum to be placed in this species without consideration of additional characters. Ducke (1907) placed *smithii* as a variety of *bilineolata* and it has not been considered a species since then. Examination of morphological characters has shown it to be a distinct species with variation in color pattern paralleling that of *bilineolata*.

It can be distinguished from *bilineolata* in northern South America by the high, well developed occipital carina (Fig. 47) and the projecting, bilobed scutellum (Fig. 57). South of the Guianas, however, the carina becomes reduced, but the scutellum remains diagnostic. In the eastern Amazon region it occurs together with *propodealis* but is distinct on the basis of the heavy punctures on the scutum, the reduced occipital carina, and the prominent scutellum.

FEMALE. (1.) Wing length $6.31 \pm .332$ mm.

Head. (2.) In frontal view .88 times as high as wide; in dorsal view .40 times as long as wide; posterior margin slightly curved. (3.) Lateral ocellus separated from eye by 1.33 times distance between lateral ocelli and from occipital carina by 1.36 times this distance; vertex with large punctures

separated by one diameter or less, often contiguous behind eye; vertex slightly convex, sloping ventrad along posterior margin only. (4.) In lateral view gena about 1.1 times as wide as eye at middle; postgenal convexity moderately developed, broadly rounded; gena about 1.6 times as wide at level of convexity as at level of eye emargination; punctures large, separated by about one diameter or less dorsally, small and more scattered ventrally, very small and sparse on convexity. (5.) Occipital carina low, acute dorsally, forming an acute, narrow ridge laterally, high, blade-like, equal to about .3 width of ocellus on convexity. (6.) Frons with medium to large sized punctures separated by one to two diameters. (7.) Clypeus about 1.7 times as wide as long, moderately convex; distal margin straight, narrowly rounded onto lateral lobe; apical triangle long, little longer than width of antennal socket, apex narrowly rounded; contact with eye equal to about .7 width of antennal socket; epistomal suture forming about a 70° angle with margin of eye, dorsally forming a flattened V; clypeal surface smooth, with few small punctures, basal 0.3 sericeous, distal marginal hairs sparse. (8.) Malar space 0.5 width of antennal socket. (9.) Antenna with flagellum moderately swollen, eighth flagellomere 1.8 times as wide as long. (10.) Head with long, golden, hairs, more or less abundant, about as long as width of ocellus on vertex, shorter elsewhere; eyes with abundant short hairs, about 0.5 width of ocellus in length; head lightly sericeous.

Thorax. (11.) Anterior surface of pronotum with few punctures, forming an obtuse angle with dorsal surface, distinctly separated from dorsal surface by keel; pronotal keel low, acute, extending almost to ventral extremity of pronotum, keel distinctly higher on humeral angle, projecting cephalad; humeral angle not well developed, rounded; dorsal surface evenly curved onto lateral surface, swollen posteriorly, with large, deep, contiguous punctures; lateral surface narrow, distinct from anterior surface, with few deep punctures; pronotal lobe wide, distinct. (12.) Scutum about .72 times as long as wide, with very large, deep, contiguous punctures. (13.) Scutellum rounded, posterior margin angular; in dorsal view 3 times as wide as long at middle, moderately bilobed, about 0.8 times as long at middle as at lateral margins, lateral margins rounded, posterior margin curved; in posterior view about 3.5 times as wide as height at middle, dorsal margin rounded laterally, slightly indented medially; in profile scutellum rounded, prominent, high, projecting over the plane of metanotum and up to or above plane of scutum; dorsal surface strongly convex, sloping dorsad posteriorly, posterior surface flat or very slightly concave; dorsal surface of scutellum rounded onto lateral surface; scutellar pocket slightly concave, pocket punctured posteriorly; dorsal surface with large, deep, contiguous punctures; posterior surface smooth, with few punctures dorsally; axillar ridge swollen, almost spheroid, broadly rounded, with small punctures. (14.) Metanotum 3.2 times as wide

as long, slightly concave; dorsal margin bowed evenly dorsad, ventral margin bowed very slightly ventrad; surface smooth with few fine punctures. (15.) Mesopleuron strongly convex; anterior and posterior surfaces with scattered small punctures; punctures large medially, contiguous or nearly so. (16.) Dorsal sclerite of metapleuron 2.5 times as high as width at middle, surface rugose, with few large irregular punctures; secondary suture indistinct; first metapleural pit small, deep; ventral sclerite of metapleuron smooth, with few punctures; metapleural-propodeal suture scarcely evident. (17.) Propodeum angular; posterior surface with broad deep concavity, median area smooth, dorsolateral area with contiguous medium sized deep punctures; lateral surface with medium to large sized, deep punctures posteriorly, smaller and scattered anteriorly, surface rugose ventrally; lateral ridge low and irregular above propodeal angle, absent below angle, forming a round lobe on angle; propodeal angle well developed, in lateral view forming a rounded right angle, in posterior view forming large, rounded, lobe-like extension. (18.) Thorax with abundant, short, golden hairs on punctured surfaces, longest on scutellum; thorax lightly sericeous.

Abdomen. (19.) Tergum 1 flattened onto tergum 2, about 5.5 times as wide as long; sternum 1 about 6 times as wide as long at middle; tergum with few fine punctures, sternum rugose with sharp transverse, median ridge. (20.) Tergum 2 about .71 times as long as wide; high, evenly rounded in profile; with small deep punctures separated by about one diameter; punctures larger on sternum. (21.) Terga and sterna 3-5 punctured as on 2, more rugose anteriorly; tergum and sternum 6 without or with few small punctures. (22.) Abdomen with abundant, moderately long, golden hairs, directed caudad, lightly sericeous.

Coloration. As in *bilineolata* except wings often darker.

MALE. (1.) Wing length 6.5 mm.

As in female except for following:

Head. (2.) In frontal view .89 times as high as wide; in dorsal view .31 times as long as wide. (3.) Lateral ocellus separated from eye by .78 times distance between lateral ocelli and from occipital carina by .8 times this distance; vertex moderately convex, posterior surface gradually sloping ventrad. (4.) In lateral view gena .38 times as wide as eye at middle; postgenal convexity very slight, gena narrowed dorsally, about 1.6 times as wide at level of convexity as at level of eye emargination. (5.) Occipital carina low, rounded dorsally, high and acute laterally, extending to convexity, low and rounded on convexity. (7.) Clypeus .72 times as long as wide, slightly convex; distal margins curved; apical triangle about 1.2 times as long as width of antennal socket, apex broadly rounded; contact with eye equal to or little more than width of antennal socket; epistomal suture forming about

a 30° angle with eye margin; clypeus entirely sericeous. (9.) Antenna with scape .53 times as long as width of clypeus; flagellum moderately swollen, eighth flagellomere 1.3 times as wide as long.

Thorax. (11.) Anterior surface of pronotum evenly curved onto dorsal surface, not distinctly separated from dorsal surface; pronotal keel low and rounded, extending little beyond humeral angle; humeral angle indistinct; dorsal surface evenly curved onto lateral surface; lateral surface not distinct from anterior surface. (13.) Scutellum more rounded; dorsal surface very convex, high, scutellum almost spheroid. (17.) Propodeal angles slightly swollen, more rounded in lateral view.

Abdomen. (24.) Spiculum very long, needlelike, at least 8 times as long as width at base.

Genitalia. (25.) Paramere 2.1 times as long as wide; apex slightly truncate, margins rounded; parameral spine about .5 times as wide at middle as at basal inflection, without distinct lateral invagination, without distinct notch at base of volsellar plate. (26.) Volsellar lobe long, very wide; in lateral view about 2 times as long as width at base; in ventral view extending to about middle of digital lobe, evenly tapered to a blunt apex; lobe strongly flattened. (27.) Cuspis appressed against paramere, apex rounded; cuspis with few black tubercles opposite base of digitus. In lateral view, digitus thick-set, rounded, about 2 times as long as width at base, posterior angle of digital lobe somewhat extended, rounded, not reaching apex of aedeagus, ventral angle round, directed anteriorly; in ventral view digital lobe ovoid, slightly wider basally than apically; digitus with small black tubercles laterally. (28.) Aedeagus in lateral view curved slightly ventrad, aedeagal lobe about 0.2 length of entire spatha, lobe moderately swollen; in ventral view, lobe evenly tapered to rounded apex, lobe about as wide as width of spatha at middle, inflected margins of lobe meeting at about middle of lobe, gradually divergent basally; spatha greatly expanded at base of lobe, to about twice width of spatha at middle, expansion with row of fine teeth along lateral margin; basal third of spatha with parallel margins, gradually narrowed at base; ventral hook long, curved laterad apically; aedeagal apodeme angular, widened apically, narrowed basally.

Coloration. Yellow markings more extensive than in female as follows: entire clypeus; ventral 0.5 of frons; scape except for small, dorsal, apical area; ventral surface of flagellum; ventral surfaces of coxae, trochanters and femora. Flagellum dark brown dorsally; mandible dull yellow basally.

TYPE MATERIAL. I have not been able to trace the type of this species. It is not in the Musée National in Paris and there are no specimens of *smithii* in Saussure's collection in Geneva. I am therefore designating a ♀ neotype for *Nectarinia smithii* Saussure. It bears the following label: "Carvoeiro, Rio

Negro-Rio Branco, Amazonas, 27-VIII-24". It agrees closely with the above description. The neotype is in the Museum of Comparative Zoology, Harvard.

VARIATION. In northern South America and Central America the occipital carina is very high on the postgenal convexity. In Central America the scutellum is low and does not project dorsad, and the punctures on the scutum are not as dense as in the Guianas. A similar situation is found in Mato Grosso and Acre where specimens may have both the high carina and low scutellum characteristic of *bilineolata* and *propodealis* and the deep, dense punctures characteristic of *smithii*. These wasps cannot be placed in any of the three species concerned and may be either an undescribed species or hybrids between *smithii* and *propodealis*.

The coloration in South America is relatively stable, the most common form having a wide discal band on the second tergum and two parallel lines on the scutum. The discal band varies somewhat but was only occasionally absent in the specimens examined.

In Costa Rica the color variation is similar to that of *bilineolata* and appears to be correlated with altitude. Specimens of the central plateau, altitude 1200 m, are dark with yellow maculations reduced, but wasps of the lowlands have the full complement of yellow markings as found in South America.

DISTRIBUTION. *Brachygastra smithii* extends from southern Mexico to southern Brazil. In South America it ranges over much of the Amazon, extending west to the Andes in Peru and Bolivia and south as far as the State of São Paulo. In its entire South American distribution it is sympatric with *bilineolata* and in western South America it occurs together with other species of the *smithii* group as well.

I have seen specimens from the following localities: **CENTRAL AMERICA.** *Costa Rica.* Prov. Cartago: 11 mi. SW. Cartago. Prov. Guanacaste: Playas del Coco. Prov. Puntarenas: Gollito; 34 km. S.E. Potrero Grande. Prov. San José: San José. *Guatemala.* Dept. Baja Verapaz: Salama. *Honduras.* Dept. Tegucigalpa: Tegucigalpa. *Mexico.* Est. Chiapas: 4 mi. S.W. Simojovel. *Panamá.* Dept. Colón: Portobelo.

SOUTH AMERICA. *Bolivia.* Dept. Beni: Cavinás on Río Beni. *Brazil.* Est. Acre: Iquiri. Est. Amazonas: Hyutanahan on Rio Purus; Rio Juruá; Tabatinga. Est. Mato Grosso: Utiariti on Rio Papagaio; Capitão Vasconcelos on Rio Tuatuari. Est. Pará: Obidos; Santarém. Terr. Roraima [= Terr. Rio Branco]: Viste Alegre. Est. São Paulo: (Eng. Cesar de Souza). *Colombia.* Dept. Boyaca: Muzo, 900 m. Dept. Magdalena: Río Frio. Dept. Santander: Puerto Olaya, 100 m. *French Guiana.* Dept. Guyane: Cayenne; Noveau Chantier; St. Jean du Maroni. *Perú.* Dept. Loreto: Río Marañon; Río Napo; Río Putamayo. *Surinam.* Dist. Nickerie: Sipaliwini.

BIOLOGY. A nest of "*bilineolata* var. *smithii*" has been figured by Ducke (1904, 1905), and other figures (Buysson, 1905; Ducke, 1910) are reproductions of his first figure. It is difficult to assign this nest to either *smithii* or *bilineolata*, but it is most likely the former species. Ducke (1910) reports that the nest is not large and has not been seen with more than four combs.

Bodkin (1917) reports a nest from British Guiana which was $\frac{3}{4}$ in. deep and $1\frac{1}{2}$ in. greatest diameter. The lateral entrance hole is in the form of a vertical slit and opens into the lowermost combs.

***Brachygastra propodealis* Bequaert**

Brachygastra bilineolata var. *propodealis* Bequaert, 1942. Jour. New York Ent. Soc. 50:305 (♀ holotype, Rio Marañon, Perú; in Museum Comparative Zoology, Harvard).

This species is distinct on the basis of the low scutellum, the high occipital carina and the moderately punctured scutum, but is almost identical to *bilineolata* and *smithii* in color and size. Its occurrence together with these species in northeastern Peru and southern Bolivia and the persistence of the above characters throughout its range indicates that it is a distinct species rather than a variety.

The scutellum of this species is very short and wide and does not project over the plane of the metanotum as in *smithii*. *B. propodealis* can be distinguished from *bilineolata* by the moderately punctured scutum and the rounded propodeal angles.

FEMALE. (1.) Wing length 6.37 mm.

Head. (2.) In frontal view .90 times as high as wide; in dorsal view .39 times as long as wide; posterior margin slightly curved. (3.) Lateral ocellus separated from eye by about 1.26 times distance between lateral ocelli and from occipital carina by 1.26 times this distance; vertex with small punctures separated by about one diameter; vertex moderately convex, posterior surface sloping slightly ventrad in profile. (4.) In lateral view gena about 1.3 times as wide as eye at middle; postgenal convexity very large, broad, posterior margin of convexity flattened medially; gena about twice as wide at level of convexity as at level of eye emargination; punctures small, separated by one diameter or less dorsally, more scattered ventrally, very small or absent on convexity. (5.) Occipital carina high, acute dorsally, slightly higher laterally, forming a very high blade-like flange on postgenal convexity, flange perpendicular to surface of convexity and equal to width of ocellus in height. (6.) Frons with medium sized punctures separated by about one diameter. (7.) Clypeus about 1.5 times as wide as long, moderately convex; distal margin straight, broadly rounded onto lateral lobe; apical triangle very long, about 1.5 times as long as width of antennal socket, narrowly rounded; contact with eye equal to about width of antennal socket; epistomal suture forming about a 45° angle with margin of eye, dorsally broadly curved; surface smooth, shiny, with few, scattered, small punctures, basal 0.2 lightly sericeous. (8.) Malar space 0.8 width of antennal socket. (9.) Antenna with flagellum moderately swollen, eighth flagellomere 1.6 times as wide as long. (10.) Head with abundant, very long, golden hairs, about as long as width of ocellus on vertex, shorter elsewhere; eyes with abundant short hairs, little less than width of ocellus in length; head very lightly sericeous.

Thorax. (11.) Anterior surface of pronotum with very few punctures dorsally, forming an obtuse angle with dorsal surface in profile, distinctly separated from dorsal surface by keel; pronotal keel low and rounded medially, higher and acute on humeral angle, extending to pronotal lobe, indistinct on lateral surface; humeral angle not well developed, rounded; dorsal surface evenly rounded onto lateral surface, slightly swollen posteriorly, with medium sized punctures separated by about one diameter; lateral surface very narrow, almost absent, not distinctly separated from anterior surface; pronotal lobe wide, distinct. (12.) Scutum about .75 times as long as wide with medium sized punctures widely spaced medially, separated by about one diameter laterally. (13.) Scutellum slightly rounded, margins more or less angular; in dorsal view scutellum about 3 times as wide as length at middle, lateral margins rounded, posterior margin curved; in posterior view 4 times as wide as height at middle, lateral margins rounded dorsally, dorsal margin strongly indented medially; in profile, scutellum slightly rounded, low, not projecting over plane of metanotum; dorsal surface flat, sloping dorsad posteriorly, posterior surface concave medially; scutellar pockets concave, dorsal surface not rounded onto lateral surface, pockets with few punctures posteriorly; dorsal surface with medium sized, shallow punctures contiguous or nearly so, posterior surface smooth ventrally with medium sized, shallow punctures dorsally; axillar ridge slightly swollen, narrowly rounded, with small punctures. (14.) Metanotum 2.6 times as wide as long, surface flat; dorsal margin slightly bowed dorsad, ventral margin slightly bowed ventrad; surface smooth with few fine punctures. (15.) Mesopleuron strongly convex; anterior and posterior surfaces with scattered small punctures; punctures large, contiguous dorsomedially, medium sized, separated by one diameter medially. (16.) Dorsal sclerite of metapleuron 3.3 times as high as width at middle; secondary suture evident as a small furrow; first metapleural pit small, shallow; ventral sclerite of metapleuron smooth; metapleural-propodeal suture evident as a shallow suture. (17.) Propodeum moderately angular; posterior surface broadly, slightly concave, median area with slightly irregular surface, dorsolateral area with small, deep, contiguous punctures; lateral surface with small to medium sized, deep punctures posteriorly, smaller more scattered ones anteriorly, surface rugose ventrally; lateral ridge irregular, low, extending little beyond propodeal angle, slightly higher on propodeal angle; propodeal angle moderately well developed, appearing as an obtuse angle in lateral view, rounded in posterior view. (18.) Thorax with abundant, long, golden hairs on punctured surfaces, longest on dorsum; thorax lightly sericeous.

Abdomen. (19.) Tergum 1 flattened onto tergum 2, in dorsal view 5.5 times as wide as long; sternum 1 about 5 times as wide as length at middle; tergum with few fine punctures; sternum rugose. (20.) Tergum 2 about .70

times as long as wide, high, evenly rounded in profile; tergum and sternum with evenly spaced, small, deep punctures separated by one to two diameters. (21.) Terga and sterna 3-5 punctured as on 2, more rugose anteriorly; tergum and sternum 6 with few punctures. (23.) Abdomen with abundant, short, golden hairs, lightly sericeous.

Coloration. Black with extensive yellow markings as follows: wide apical and lateral margins of clypeus; interantennal area; wide margin of inner orbit; vertex except for lateral margins of ocular swelling; anterior half of gena; ventral surface of scape; dorsal and lateral surface of pronotum; two medially narrowed, longitudinal bands on scutum; scutellum; metanotum; large rectangular, subtegular spot on mesopleuron; lateral portions of posterior surface of propodeum; ventral surfaces of coxae and tibiae; wide apical bands on terga 1-5 and sterna 2-5; wide discal band on tergum 2; anterior margin of sternum 2; apices of tergum and sternum 6. Mandible light brown, flagellum and legs dark brown.

VARIATION. The color pattern of *propodealis* is similar to that of *smithii* and *bilineolata* but differs in having the posterior surface of the propodeum almost entirely yellow. It is interesting to note that the extent of the scutal lines is not at all correlated with the development of the discal band of the second tergum, whereas in the other species of this group, loss of these lines is usually associated with loss of the discal band and an over-all reduction of yellow pigmentation.

DISTRIBUTION. *Brachygastra propodealis* is known only from the headwaters of the Amazon, extending south from northeastern Peru to northern Bolivia. Throughout much of its range it is found together with other species of the *smithii* group. In northeastern Peru, for example, it occurs together with *bilineolata*, *buyssoni* and *smithii*. Its range, therefore, is sympatric with all these species but does not appear to be as extensive as any of them.

Specimens have been examined from the following localities: *Bolivia.* Dept. Beni: Rurrenabaque on Río Beni. Dept. Chochabamba: Río Chapare, Tropical Region, 400 m. Dept. La Paz: Tumupasa. *Brazil.* Est. Guaporé: Pôrto Velho. *Perú.* Dept. Loreto: Middle Río Marañon. Dept. Huánuco: Monzon Valley, Tingo María; Pucallpa and Aguaytia; Tingo María. Dept. Pasco: Iscozazín.

***Brachygastra buyssoni* (Ducke) new combination**
(Figs. 50, 66)

Nectarinia buyssoni Ducke, 1905. Rev. Ent. (Caen) 24:11.

Ducke's description, "scutello fortiter exciso et prominente, segmento mediano valde concavo et compressobidentato," leaves little doubt as to the identity of this interesting, seldom seen species. It is a large (7 mm.), black species with pale yellow markings similar to those of *smithii* and *bilineolata*. As Ducke noted, it is unique in the extreme development of the scutellum and propodeal angles.

Brachygastra buyssoni superficially resembles other species of the *smithii* group because of its similar color pattern, but it is larger and is marked with a light yellow, almost white pattern, while the other species have a distinct yellow. The propodeum is produced laterally into very large triangular projections (Fig. 66), the propodeal angles, and the scutellum is prominent, projecting over the plane of the metanotum and above the plane of the scutum. In addition the postgenal convexity is very large and bears the curved, blade-like occipital carina (Fig. 50). Although the latter characters are well developed in both *baccalaurea* and *smithii*, the convexity and carina are never as large as in *buyssoni*. Unusually dark specimens from higher elevations may resemble *lecheguana* but examination of the above mentioned characters facilitates separation of these species.

FEMALE. (1.) Wing length 6.85 mm.

Head. (2.) In frontal view .87 times as high as wide; in dorsal view about .42 times as long as wide; posterior margin moderately curved. (3.) Lateral ocellus separated from eye by about 1.4 times distance between lateral ocelli and from occipital carina by about 1.6 this distance; vertex with medium sized punctures separated by one diameter or less posterior to eye, widely spaced lateral to lateral ocelli; vertex slightly convex, posterior surface sloping slightly ventrad. (4.) In lateral view gena about as wide as eye in middle; postgenal convexity very large, round; gena about 1.75 times as wide at level of convexity as at level of eye emargination; punctures medium sized dorsally, separated by two diameters or less, diminishing in size ventrally, very fine and widely spaced at level of convexity. (5.) Occipital carina low, rounded, more or less distinct dorsally, extending onto postgenal convexity laterally, forming a wide, curved, blade-like flange, as high as or higher than width of ocellus, perpendicular to surface of gena, terminating at mandibular condyle. (6.) Frons with medium sized punctures separated by one diameter. (7.) Clypeus about 1.7 times as wide as long, moderately convex; distal margin straight, narrowly rounded onto lateral lobe; apical triangle large, about 1.5 times width of antennal socket in length, apex narrowly rounded; contact with eye equal to about 0.5 width of antennal socket; epistomal suture forming about a 60° angle with eye margin, dorsally indistinct, forming a flattened V; clypeal surface smooth, shiny, with few, scattered fine punctures, basal 0.2 sericeous. (8.) Malar space about 0.7 times width of antennal socket. (9.) Antenna with flagellum moderately swollen, eighth flagellar segment about 1.5 times as wide as long. (10.) Head with short, erect, fine, white hairs as long as width of ocellus on vertex, much shorter elsewhere; eye with very short hairs; head lightly sericeous.

Thorax. (11.) Anterior surface of pronotum smooth, shiny, with few small scattered punctures, in profile forming a right angle with dorsal surface, distinctly separated from dorsal surface; pronotal keel low medially,

rounded below humeral angle, developed into high ridge inflected cephalad at humeral angle; humeral angle rounded in dorsal and lateral views; dorsal surface evenly curved onto lateral surface, with large, deep punctures, almost contiguous anteriorly, separated by one diameter near posterior margin; lateral surface narrow, with few medium sized punctures; pronotal lobe wide, indistinct. (12.) Scutum about .75 times as long as wide; punctures large, deep, contiguous or nearly so anteriorly, separated by two diameters or less posteriorly. (13.) In dorsal view scutellum about 3 times as long as width at middle, strongly bilobed, about .75 times as long at middle as at lateral margin, posterior margin forming a flattened V; in posterior view about 4 times as wide as height at middle, dorsal margin bowed strongly dorsad laterally; in profile scutellum projecting posterodorsally as high as scutum, dorsal surface forming a distinct acute angle with posterior surface; dorsal surface slightly convex with large deep contiguous punctures, posterior surface flat, smooth, with scattered medium sized punctures; scutellar pocket small, heavily punctured apically; axillar ridge short, swollen, almost spheroid, punctured. (14.) Metanotum about 3 times as wide as long, slightly concave medially; dorsal margin evenly bowed dorsad, ventral margin very slightly bowed ventrad; surface smooth with few small punctures. (15.) Mesopleuron strongly convex; with medium sized punctures separated by one diameter or less dorsally, smaller ventrally; anterior and posterior surfaces with few small punctures. (16.) Dorsal sclerite of metapleuron 3 times as high as wide at middle, with few medium sized punctures; secondary suture indistinct; first metapleural pit small, shallow; ventral sclerite with few small punctures, metapleural-propodeal suture evident as shallow furrow. (17.) Propodeum greatly developed, angular; entire posterior surface strongly concave, finely rugulose; dorsolateral areas with large, contiguous, shallow punctures; lateral surface with large, contiguous punctures posteriorly, smaller ones anteriorly, few ventrally; lateral ridge irregular on propodeal angle, distinct below propodeal angle; propodeal angle greatly developed forming a posterolateral triangular projection about as long as height of propodeum. (18.) Thorax with short, erect golden hairs in punctured areas, longer on scutum and propodeum than elsewhere; thorax lightly sericeous.

Abdomen. (19.) Tergum 1 flattened onto tergum 2, scale-like, almost 5 times as wide as long in dorsal view; sternum 1 about 5 times as wide as long in dorsal view; tergum with small scattered punctures, sternum rugose with acute, transverse ridge. (20.) Tergum 2 about .72 times as long as wide, high, abruptly convex in profile; with dense, evenly spaced, small, deep punctures separated by about one diameter; sternum 2 with small punctures more widely spaced. (21.) Terga and sterna 3-5 with small punctures separated by about three diameters; tergum and sternum 6 with few fine punctures.

(22.) Abdomen with short, golden hairs directed caudad, lightly sericeous.

Coloration. Black with light yellow markings as follows: two inter-antennal spots mediodorsal to antennal sockets; lateral and distal margins of clypeus; inner orbit from epistomal suture to emargination; wide band extending from mandibular articulation to median genal area; two elongate spots posterolateral to posterior ocelli forming a flattened V interrupted medially; median edge of pronotal keel; small spot on humeral angle; posterior tips of pronotum; subtegular spot on mesopleuron; axilla; dorsal half of metanotum; narrow apical margins of abdominal terga 1-6; narrow apical margins of sterna 2-5; narrow transverse discal band on tergum 2. Wings clear, veins dark brown.

TYPE MATERIAL. The holotype, a female from Tabatinga, Amazonas, Brazil, collected by Ducke, may be in the Museu Goeldi, Belém, Brazil. Additional specimens collected by Ducke are in the Musée National d'Histoire Naturelle, Paris.

DISTRIBUTION. The species was originally believed to be restricted to the headwaters of the Amazon but I have seen a specimen from the Rio Xingu in Mato Grosso which unmistakably belongs to this species. Additional specimens from Bolivia and Peru indicate its wide distribution.

Specimens have been examined from the following localities: *Brasil.* Est. Mato Grosso: Aldeia Juruna on the Rio Xingu. *Perú.* Dept. Huánuco: Tingo María. Dept. Loreto: Middle Río Ucayali.

In the literature, references are found to the following localities: *Bolivia.* Dept. La Paz: Tumupasa (Bequaert, 1932). *Brasil.* Est. Amazonas: Tabatinga (Ducke, 1905). *Perú.* Dept. Loreto: Iquitos (Ducke, 1908).

The *B. lecheguana* Group

The species of this group have the following common characteristics: occipital carina not well developed on ventral half of gena; postgenal convexity absent or very weak; pronotal keel low, not projecting cephalad on humeral angle; scutellum angular; color pattern relatively stable, yellow maculations only on frons and apical margins of abdominal segments. The nests of this group are large and often persist for several years.

The species of this group have been grouped under one species, *lecheguana*, in the literature. On the basis of male characters, the material is here divided as follows:

B. mellifica (Say) in Mexico and Central America north of Costa Rica; *B. lecheguana* (Latreille), widespread in South America; *B. borellii* (Zavattari) in the southern Andean regions.

Brachygastra mellifica (Say) new combination

(Figs. 22-24)

Polistes mellifica Say, 1837. Boston Jour. Nat. Hist. 1(4):390 (♀ ♂, near Jalapa, Mexico—lost; ♂ neotype, Veraacruz, Mexico, by present designation in the collection of the University of California, Berkeley).

Nectarinia mellifica; Saussure, 1853-1858. Et. Fam. Vesp. 2:226, 232, 233.

- Nectarina lecheguana*; Buysson, 1905. Ann. Soc. Ent. France 74:542, 547, 558, pl. 11, figs. 1-7, pl. 12, figs. 1-3, 6-8, 10, 13, pl. 15, 16 (in part).
- Nectarina mellifica*; Smith, 1857. Cat. Hymen. Brit. Mus. 5:137.
- Nectarina mellifera*; Dalla Torre, 1904. in Wytsman, Gen. Insect., fasc. 19:86.
- Caba lecheguana*; R. von Ihering, 1904. Rev. Mus. Paulista 4:106, 109 (in part) (misidentification).
- Caba* (*Nectarina*) *mellifica*; Barber, 1905. Proc. Ent. Soc. Washington 7:25.
- Nectarina lecheguana* var. *velutina*; Buysson, 1905. Ann. Soc. Ent. France 74:547, 563 (in part).
- Chartergus aztecus* Cameron, 1906. Invertebrata Pacifica 1:154 (♀, Mexico; in British Museum).
- Chartergus arizonaensis* Cameron, 1907. Invertebrata Pacifica 1:181, 182 (♀, Nogales, Arizona; in British Museum).
- Chartergus centralis* Cameron, 1907. Invertebrata Pacifica 1:181, 182 (2 ♀♀, Chimandega, Nicaragua and Champerico, Guatemala; in British Museum).
- Nectarina cameroni* Meade-Waldo, 1911. Ann. Mag. Nat. Hist. (8)7:112. New name for *Chartergus aztecus* Cameron, 1906.
- Brachygastra lecheguana*; Bequaert, 1944. Bull. Mus. Comp. Zool. 94:271, 272 (in part).
- Brachygastra lecheguana* var. *velutina*; Richards and Richards, 1951. Trans. R. Ent. Soc. London 102:26 (in part).

Brachygastra mellifica has long been considered a synonym of *lecheguana* and all references to the latter species north of Panama are references to *mellifica*. Although the females are often very similar and difficult to separate, the male genitalia of *mellifica* are distinct from those of *lecheguana* on the basis of the elongate digital lobe of the volsella (Fig. 23). No intermediates have been found, and the few male specimens of *lecheguana* seen from Panama are distinctly different from males of *mellifica* from Honduras.

The only positive way of separating *mellifica* from *lecheguana* is on the basis of male characters. If males are unavailable, locality must serve as the diagnostic character. The majority of females of *mellifica* differ from *lecheguana* by the almost straight posterior margin of the scutellum, but this character varies in both species, particularly in the latter.

FEMALE. (1.) Wing length $7.44 \pm .242$ mm.

Head. (2.) In frontal view .87 times as high as wide; in dorsal view .43 times as long as wide; posterior margin slightly curved, almost straight. (3.) Lateral ocellus separated from eye by 1.25 times distance between lateral ocelli and from occipital carina by 1.25 times this distance; vertex with small punctures separated by about one diameter, occasionally contiguous posterior to eye; vertex strongly convex, posterior surface sloping ventrad in profile. (4.) In lateral view gena about as wide as eye at middle; postgenal convexity absent, posterior margin curving gradually towards mandibular condyle; gena about as wide on ventral half as at level of eye emargination; punctures small, scattered, occasionally contiguous or forming long rows, slightly smaller ventrally. (5.) Occipital carina low, acute, becoming lower, occasionally indistinct on ventral third of gena. (6.) Frons with small, deep punctures separated by about one diameter or less. (7.) Clypeus about 1.6 times as wide as long, slightly convex; distal margin curved, narrowly rounded onto lateral lobe; apical triangle about as long as width of antennal socket, apex broadly rounded; contact with eye equal to about 0.8 times width of antennal

socket; epistomal suture forming about a 60° angle with margin of eye, curved slightly ventrad medially; surface smooth, shiny, with widely spaced, small punctures, basal 0.3 lightly sericeous, distal marginal hairs sparse, longer apically than laterally. (8.) Malar space about 0.3 times width of antennal socket. (9.) Antenna with flagellum moderately swollen, eighth flagellomere 1.5 times as wide as long. (10.) Head with abundant, long, erect, golden hairs, recurved distally, little longer than width of ocellus on vertex, shorter elsewhere; eye with abundant, short, erect, golden hairs; head golden sericeous.

Thorax. (11.) Anterior surface of pronotum with scattered small punctures dorsally, distinctly separated from dorsal surface; pronotal keel, low, obtuse medially, higher and acute laterally, extending to humeral angle, absent on lateral surface; humeral angle developed into a distinct angular shoulder projecting cephalad; dorsal surface abruptly rounded onto lateral surface, with deep, medium sized punctures separated by about one diameter; lateral surface narrow, not distinctly separated from anterior surface, with small to medium sized punctures separated by about one diameter; pronotal lobe wide, distinct. (12.) Scutum .85 times as long as wide with evenly spaced, small punctures separated by about one to two diameters. (13.) In dorsal view scutellum about 2 times as wide as long, very slightly bilobed, only slightly longer at lateral margin than at middle, posterior margin almost straight; in posterior view about 5 times as wide as height at middle, dorsal margin straight; in profile scutellum angular, projecting slightly over plane of metanotum, not projecting above plane of scutum; scutellar pocket flat, punctured; dorsal surface slightly convex; posterior surface slight concave; dorsal surface with medium sized shallow punctures separated by about one diameter anteriorly, contiguous posteriorly; posterior surface smooth with few punctures dorsally; axillar ridge wide, swollen, with small punctures. (14.) Metanotum about 3 times as wide as long, flat; dorsal margin bowed evenly dorsad, occasionally forming slightly rounded lip, ventral margin slightly curved; surface with small punctures dorsolaterally. (15.) Mesopleuron moderately convex with scattered small punctures on anterior and posterior surfaces; punctures large to medium sized medially, surface rugose, irregularly punctured dorsally. (16.) Dorsal sclerite of metapleuron about twice as wide as high with scattered small punctures; secondary suture indistinct; first metapleural pit wide, deep; ventral sclerite of metapleuron with few fine punctures; metapleural-propodeal suture evident as a shallow furrow. (17.) Propodeum angular; posterior surface with narrow, moderately deep concavity without punctures, dorsolateral area irregularly punctured, rugose; lateral surface with small to medium sized punctures separated by about one diameter; lateral ridge low, irregular below propodeal angle; propodeal angle slightly swollen, bearing a prominent blade-like, rounded

lobe, acutely projecting in lateral view, forming round lateral lobe in posterior view. (18.) Thorax with abundant long golden hairs, recurved distally; densely golden sericeous.

Abdomen. (19.) Tergum 1 distinctly set off from tergum 2, about 6 times as wide as long in dorsal view; sternum 1 about 5 times as wide as long; tergum with fine punctures, sternum rugulose. (20.) Tergum 2 about .80 times as long as wide; low, abruptly convex in profile with very small punctures, separated by about two to four diameters, larger laterally than medially; sternum 2 with punctures as on tergum. (21.) Terga and sterna 3-5 with widely spaced, small punctures, tergum and sternum 6 with few punctures. (22.) Abdomen with abundant, short, curved hairs, directed caudad, lightly sericeous.

Coloration. Black with yellow markings more or less developed as follows; small area on lower inner orbit; median area of pronotal keel; portions of dorsal margin of metanotum; narrow apical bands on terga 1-5 and sterna 2-5; tergum and sternum 6. Mandible, antenna and legs dark brown. Wings dark yellow, blackened apically.

MALE. (1.) Wing length $7.52 \pm .212$ mm.

As in female except for following:

Head. (2.) In frontal view .86 times as high as wide; in dorsal view .37 times as long as wide. (3.) Lateral ocellus separated from eye by about .78 times distance between lateral ocelli and from occipital carina by 0.9 times this distance; vertex strongly convex, posterior margin almost vertical. (4.) Gena .43 times as wide as eye in lateral view; postgenal convexity very slight; gena about as wide at level of convexity as at level of eye emargination. (5.) Occipital carina low, rounded, extending about 0.6 length of gena, absent ventrally. (7.) Clypeus 1.3 times as wide as long, slightly convex; distal margin curved; apical triangle slight, about 0.5 times as long as width of antennal socket, apex broadly rounded; contact with eye equal to about width of antennal socket; epistomal suture forming about a 30° angle with eye margin; clypeus entirely sericeous. (8.) Malar space .2 times width of antennal socket. (9.) Antenna with scape .55 times as long as width of clypeus; flagellum moderately swollen, eighth flagellomere 1.5 times as wide as long.

Thorax. (11.) Pronotal keel low, ending abruptly at humeral angle; humeral angle not developed into distinct shoulder, forming a slight conical swelling, dorsal surface curved evenly onto lateral surface. (13.) Scutellum with dorsal surface more convex; punctures larger, deeper; scutellar margins more rounded. (17.) Propodeum more rounded; propodeal angles obtuse, not acutely projecting.

Abdomen. (24.) Spiculum long, pointed about 2.3 times as long as width at base.

Genitalia. (25.) Paramere 2.2 times as long as high, apex roundly truncate; parameral spine about 0.5 times as wide at middle as at basal inflection, with lateral invagination; shallow notch at base of volsellar plate. (26.) Volsellar lobe very long, attenuate, 5 times as long as width at base, slightly tapered, apex rounded; lobe curved laterally, slightly depressed, extending little beyond middle of digital lobe. (27.) Cuspis flattened against paramere, pointed in lateral view; cuspis bearing few black tubercles opposite base of digitus. In lateral view digitus elongate, pointed, about 3 times as long as wide at base, posterior angle of digital lobe greatly extended, almost reaching apex of aedeagus, ventral angle produced into a long pointed ventral projection; in ventral view posterior angle long, pointed; ventral angle rounded, projecting laterally; digitus with small black tubercles laterally. (28.) Aedeagus in lateral view curved evenly ventrad, aedeagal lobe about 0.3 length of entire spatha, lobe slightly swollen; in ventral view lobe about 1.8 times as wide at apex as at base, lobe at most 2 times as wide as width of spatha at middle, lobe with lateral margins inflected mesad about 0.4 width of lobe; inflected margins parallel along middle of lobe, slightly divergent elsewhere; ventral hook short, wide, triangular, curved slightly laterad apically; aedeagal apodeme with ventral swelling forming a right angled ventral margin, dorsal margin evenly curved.

Coloration. Black with yellow markings more or less developed as follows: inner orbits; two interantennal spots; area ventral to antennal sockets; distal margin of clypeus; ventral surface of scape; base of mandible; pronotal keel; tegula; axillar ridge; portions of dorsal surface of scutellum; antero-ventral surfaces of coxae; portions of ventral surfaces of trochanters and tibiae; apical bands on terga 1-6; sterna 2-6; tergum and sternum 7. Flagellum light ferruginous. Apex of mandible and legs dark brown.

TYPE MATERIAL. As virtually all of Say's types have been lost, apparently including that of *mellifica*, I am designating a neotype for *Polistes mellifica* because of the similarity of this species to *lecheguana*. The neotype is a male with the following labels: Vera Cruz, V.C., Mex., VI-20-51; P. D. Hurd collector. The genitalia have been dissected and are in a small vial attached to the pin. It is in the collections of the University of California at Berkeley.

VARIATION. Characters that vary in *B. mellifica* include the height of the occipital carina, the posterior margin of the scutellum, and the lateral ridge of the propodeum. The variation of these characters is slight and occurs throughout the range and at any one locality. The posterior scutellar margin is straight in the majority of individuals but may be slightly V-shaped or broadly concave. In western Costa Rica the margin may be distinctly V-shaped but is rarely as emarginate as it is in *lecheguana* in central Panama where it reaches the extreme condition for the *lecheguana* group. The de-

velopment of the scutellum appears to be correlated with the lobe of the lateral ridge of the propodeum.

The majority of specimens of *mellifica* have narrower abdominal bands than *lecheguana* but the width of the bands is variable. The bands are distinctly narrower in western and central Mexico than on the eastern coast of Mexico and in the countries to the south. In Mexico the size of the facial maculations is correlated with the width of the bands but in Central America these maculations may be lacking or reduced in wasps which have well developed maculations on the scutellum, metanotum and abdomen.

DISTRIBUTION. *Brachygastra mellifica* extends from southern Texas and Arizona to western Costa Rica and possibly western Panama. It is not found in the dry regions of northern Central Mexico, but is very common in the coast states and the southern half of Mexico.

Specimens have been examined from the following localities: CENTRAL AMERICA. *British Honduras.* Belize; Corozal. *Costa Rica.* Prov. Alajuela; San Fernando. Prov. Guanacaste: Filadelfia; 18 km E. Liberia; Playas del Coco. Prov. Puntarenas: Barranca; Puntarenas. *El Salvador.* Dept. San Salvador: 4 mi. S., 5 mi. N., and Quezaltepeque; San Salvador. *Guatemala.* Dept. Chimaltenango: Pochuta, 1000 m. Dept. Escuintla: San José. Dept. Guatemala: Guatemala City. Dept. Jiutapa: Tiucal. Dept. Santa Rosa: Amatitlán. Dept. Suchitepequez: Moca, 1000 m. Dept. Vera Paz: Salamanca. (Nueva Concepción; Yepocapa). *Honduras.* Dept. Tegucigalpa; Zamorano, 20 mi. from Tegucigalpa. Dept. Yoro: Subirana.

NORTH AMERICA. *Mexico.* Many localities in the following states: Campeche, Chiapas, Colima, Guerrero, Hidalgo, Jalisco, Mexico, Michoacán, Morelos, Nuevo León, Oaxaca, Puebla, San Luis Potosí, Sinaloa, Sonora, Tamaulipas, Veracruz, Yucatán. *United States.* Arizona. Nogales, Texas. Cameron Co.: Brownsville, Rio Hondo. Hidalgo Co.: Edinburg, McAllen, Mission, Progresso, Weslaco. Kleberg Co.: Kingsville.

BIOLOGY. The biology of this species has been summarized by Bequaert (1932) with *Nectarina lecheguana*. This wasp, like *lecheguana*, has long been known and often been cultured for its honey. Saussure gave the first descriptions and figures of the nest of this species. The nest is spherical and often built incorporating one or several supporting branches. The envelope is of tough paper and has irregular patches of shallow cells which are destined to become the outermost comb covered by yet another envelope. The interior structure is a modified type of the phragmocyttarous arrangement, spherical phragmocyttarous of Saussure. The arrangement is such that the combs are strongly convex, almost spherical with the cells opening outward. Although it appears to be a series of spherical combs, one inside the other, it is, in fact, a single comb extended in a spiral fashion, *i.e.*, the combs are continuous. Passageways between the various levels continue this spiral pattern as short continuous ramps. This arrangement provides a very efficient utilization of space, and enables a very large population to occupy a relatively small space. Schwarz (1929) reported a nest with a population of about 15,000 and I have seen a colony of an estimated 10,000 individuals.

The colonies are perennial and may persist many years. In Mexico the nests are kept for the honey which is taken annually by removing all but the

uppermost portions of the nest. The wasps then rebuild the nest on the old base. The activity of a colony throughout the year is quite seasonal. Schwarz reported that in January, in Texas, nests had no larvae or honey, and I have seen a colony in August in Costa Rica in a similar condition. Perhaps the activity of reproduction is restricted to the most favorable season during which both larval food and nectar are available. The wasps are not dormant during the unfavorable season but remain active in the empty nest and in the field.

Brachygastra lecheguana (Latreille)

(Figs. 1-9, 13, 15-18)

- Vespa sericea* Fabricius, 1804. Syst. Piezat., p. 266 (♀, South America; lectotype in Universitettes Zoologiske Museum, Copenhagen, by present designation). Not *Vespa sericea* Olivier, 1791.
- Polistes lecheguana* Latreille, 1824. Mem. Mus. Hist. Nat., Paris 11:317 (♀, Brazil).
- Brachygastra analis* Perty, 1833. Delectus Anim. Artic. Brasil., p. 146 (no sex given, State of Piaui, Brazil).
- Nectarina analis*; Swainson and Shuckard, 1840. On the History and Natural Arrangement of Insects, p. 183.
- Vespa lecheguana*; Swainson and Shuckard, 1840. On the History and Natural Arrangement of Insects, p. 183.
- Brachygastra velutina* Spinola, 1841. Ann. Soc. Ent. France 10:126, pl. 3, fig. 5 (2 ♀♀, Cayenne, French Guiana; in Museo di Zoologia, Torino). New synonymy.
- Melissia lecheguana* White, 1841. Ann. Mag. Nat. Hist. 7:320. New name for *Nectarinia lecheguana* (Latreille).
- Epipone lecheguana*; Curtis, 1844. Proc. Linn. Soc. London 1(20):188.
- Brachygastra aurulenta* Erichson, 1848. in Schomburgk, Reisen in British Guiana 3:590. New synonymy.
- Nectarinia analis*; Saussure, 1853-1858. Et. Fam. Vesp. 2:226, 230, 232.
- Nectarinia binotata* Saussure, 1853-1858. Et. Fam. Vesp. 2:230 (♂, Cayenne, French Guiana; in Musée National d'Histoire Naturelle, Paris; labeled Colombia).
- Nectarinia lecheguana*; Saussure, 1853-1858. Et. Fam. Vesp. 2:226, 231, 232, pl. 34, figs. 1, 3.
- Nectarinia velutina*; Saussure, 1853-1858. Et. Fam. Vesp. 2:226, 237.
- Chartesia sericeus*; Mobius, 1856. Abh. Naturw. Ver. Hamburg 3:144, pl. 15.
- Nectarinia aurulenta*; Smith, 1857. Cat. Hymen. Brit. Mus. 5:137.
- Nectarina binotata*; Smith, 1857. Cat. Hymen. Brit. Mus. 5:136.
- Nectarinia lecheguana*; Smith, 1857. Cat. Hymen. Brit. Mus. 5:136.
- Nectarina velutina*; Smith, 1857. Cat. Hymen. Brit. Mus. 5:137.
- Nectarina sericea*; Saussure, 1867. Reise der Novara, pp. 22, 23.
- Caba analis*; R. von Ihering, 1904. Rev. Mus. Paulista 4:107, 113.
- Caba binotata*; R. von Ihering, 1904. Rev. Mus. Paulista 4:107.
- Caba lecheguana*; R. von Ihering, 1904. Rev. Mus. Paulista 4:106, 109 (in part).
- Nectarina lecheguana* var. *binotata*; Buysson, 1905. Ann. Soc. Ent. France 74:547, 563.
- Nectarina lecheguana* var. *velutina*; Buysson, 1905. Ann. Soc. Ent. France 74:547, 563 (in part).
- Caba lecheguana* var. *velutina*; Zavattari, 1906. Boll. Mus. Anat. Comp. (Torino) 21(529):3, 4.
- Brachygastra lecheguana*; Bequaert, 1944. Bull. Mus. Comp. Zool. 94:271, 272 (in part).
- Brachygastra lecheguana* var. *velutina*; Bequaert, 1944. Bull. Mus. Comp. Zool. 94:272.

Because of the abundance and wide distribution of this species, there have been many references to it and its interesting nesting habits. Similarly, there have been numerous forms described and the synonymy is particularly lengthy. Bequaert (1932) gives an excellent history of this species but his synonymy does not separate *mellifica*.

B. lecheguana, one of the largest species of the genus (total length about 8 mm.), is a predominantly black wasp with yellow abdominal bands. It is

similar to *mellifica* of North and Central America but has the scutellum usually more emarginate posteriorly (Figs. 9, 12). The males are distinct on the basis of the rounded, blunt digital lobe (Fig. 18) which in *mellifica* is attenuated posteriorly (Fig. 24).

FEMALE. (1.) Wing length $7.33 \pm .349$ mm.

Head. (2.) In frontal view .85 times as high as wide; in dorsal view .43 times as long as wide; posterior margin slightly curved. (3.) Lateral ocellus separated from eye by 1.25 times distance between lateral ocelli and from occipital carina by 1.36 times this distance; vertex with small, contiguous punctures anterior to lateral ocelli, punctures medium sized, separated by about one diameter posterior to lateral ocelli; vertex strongly convex, posterior surface sloping ventrad in profile. (4.) In lateral view gena about 1.4 times as wide as eye at middle; postgenal convexity absent, ventral half of posterior margin of gena gradually curved, gena widest at middle; gena about as wide on ventral half as at level of eye emargination; punctures medium sized, separated by one to four diameters dorsally, smaller, more scattered ventrally. (5.) Occipital carina low, acute, of even height, extending to mandibular condyle. (6.) Frons with medium sized punctures separated by one diameter or less, often contiguous medially. (7.) Clypeus about 1.7 times as wide as long, slightly convex; distal margin curved, broadly rounded onto lateral lobe; apical triangle long, about as long as width of antennal socket; contact with eye equal to about 0.8 width of antennal socket; epistomal suture forming about a 60° angle with eye margin, dorsally forming a broadly flattened V; surface smooth, with scattered small punctures, basal 0.8 sericeous. (8.) Malar space about 0.4 width of antennal socket. (9.) Antenna with flagellum moderately swollen, eighth flagellomere about 1.5 times as wide as long. (10.) Head with abundant, erect golden hairs about as long as width of ocellus, slightly longer on vertex; eye with abundant short hairs about 0.5 times as long as width of ocellus; head densely golden sericeous.

Thorax. (11.) Anterior surface of pronotum with few scattered punctures dorsolaterally, distinctly separated from dorsal surface of pronotum; pronotal keel low, acute, slightly higher laterally than medially, extending to humeral angle only, absent on lateral surface; humeral angle developed into a distinct shoulder, rounded; dorsal surface abruptly rounded onto lateral surface, with deep, medium to large sized punctures separated by less than one diameter; lateral surface not distinctly separated from anterior surface, with large contiguous punctures dorsally, small ventrally; pronotal lobe wide, distinct. (12.) Scutum about 0.8 times as long as wide with evenly spaced, medium sized punctures separated by two to three diameters. (13.) Scutellum in dorsal view about 2.3 times as wide as long, moderately bilobed, about 0.8 as long at middle as at lateral margin, posterior margin forming a flat-

tened V; in posterior view about 5.5 times as wide as height at middle, dorsal margin depressed medially, rounded laterally; in profile, scutellum angular, forming an acute angle projecting over plane of metanotum, not extending above plane of scutum; dorsal surface slightly convex, posterior surface slightly concave; scutellar pocket flat, punctured; dorsal surface with large, deep contiguous punctures, posterior surface with few medium sized punctures along dorsal margin; axillar ridge swollen, wide, with small punctures. (14.) Metanotum 3 times as wide as long, flat; dorsal margin bowed evenly dorsad, with slight rounded lip, ventral margin broadly sinuate; surface smooth with few small dorsolateral punctures. (15.) Mesopleuron moderately convex; anterior and posterior surfaces with scattered small punctures; large, shallow, contiguous punctures mediodorsally, punctures separated by about one diameter ventrally. (16.) Dorsal sclerite of metapleuron 2.5 times as high as width at middle, with small punctures separated by about one diameter; secondary suture indistinct; first metapleural pit wide, deep; ventral sclerite of metapleuron with scattered fine punctures; metapleural-propodeal suture evident as wide, shallow furrow. (17.) Propodeum angular; posterior surface with narrow, deep, median, smooth concavity, dorsolateral areas rugose; lateral surface with medium sized punctures, contiguous posteriorly, smaller and more scattered elsewhere, rugose ventrally; lateral ridge incomplete, present only on propodeal angles and immediately below; propodeal angle with compressed, blade-like rounded projection, forming a rounded right angled lobe in lateral view, an abruptly truncate, lateral shelf-like ridge in posterior view. (18.) Thorax with dense, short, golden hairs on punctured surfaces, densely golden sericeous.

Abdomen. (19.) Tergum 1, flattened, scale-like, not distinctly set off from tergum 2, about 6 times as wide as long in dorsal view; sternum 1 about 6 times as wide as long; tergum with few fine punctures laterally; sternum rugulose. (20.) Tergum 2 about .78 times as long as wide, distinctly wider than thorax in dorsal view; low, abruptly convex in profile, with evenly spaced very small punctures medially, becoming larger laterally; sternum 2 with small punctures separated by two to three diameters medially, closer laterally. (21.) Terga and sterna 3-5 with punctures as on 2; tergum and sternum 6 with few small punctures. (22.) Abdomen with abundant golden hairs of medium length, directed caudad; abdomen densely sericeous.

Coloration. Black with yellow markings more or less developed as follows: small, ventral spot on inner orbit; median area of pronotal keel; axillar ridge; dorsal margin of metanotum; wide apical bands on terga 2-5, sterna 2-5; tergum and sternum 6. Flagellum, apex of mandible, legs dark brown. Wings yellow to dark brown, apices darker.

MALE. (1.) Wing length $7.60 \pm .417$ mm.

As in female except for following:

Head. (2.) In frontal view .86 times as high as wide; in dorsal view .36 times as long as wide. (3.) Lateral ocellus separated from eye by .81 times distance between lateral ocelli and from occipital carina by .95 times this distance; vertex strongly convex, posterior surface almost vertical. (4.) Gena about .34 times as wide as eye in lateral view; postgenal convexity absent, gena slightly wider ventrally than dorsally. (5.) Occipital carina low dorsally, somewhat higher on dorsal 0.7 of gena, absent on ventral 0.3. (7.) Clypeus about 1.4 times as wide as long, moderately convex; distal margin curved, apex broadly rounded; apical triangle about 0.8 times width of antennal socket; contact with eye equal to about 1.5 times width of antennal socket; epistomal suture forming about a 30° angle with margin of eye; clypeus entirely sericeous. (8.) Malar space very short. (9.) Scape about 0.5 times width of clypeus; flagellum slightly swollen, eighth flagellomere about 1.25 times as wide as long.

Thorax. (11.) Pronotal keel high, acute, ending abruptly at humeral angle; humeral angle not developed into a distinct shoulder, at most forming a low, broadly conical convexity; dorsal surface sloping gradually onto lateral surface. (13.) Scutellum with dorsal surface convex, heavily punctured; scutellum more rounded. (17.) Propodeum more rounded; lateral ridge often well developed; propodeal angle less well developed, obtuse in lateral view.

Abdomen. (24.) Spiculum long, wide, evenly tapered to rounded apex, about twice as long as width at base.

Genitalia. (25.) Paramere about 2 times as long as high; apex truncate, rounded; parameral spine about 0.5 times as wide at middle as at basal inflection, with lateral invagination; paramere with wide, shallow notch at base of volsellar plate. (26.) Volsellar lobe long, finger-like, about twice as long as width at base, slightly tapered distally, apex rounded; lobe curved slightly laterad, depressed, extending to middle of digital lobe. (27.) Cuspis flattened against paramere, apex pointed; cuspis bearing black tubercles opposite base of digitus. In lateral view digitus thick-set, about twice as long as width at base, posterior angle of digital lobe not extended, forming a rounded right angle, ventral angle greatly produced forming a long ventral projection rounded apically; in ventral view posterior angle blunt, rounded, ventral angle rounded, projecting slightly laterad; digitus with many small black tubercles laterally. (28.) Aedeagus in lateral view evenly curved ventrad; aedeagal lobe about 0.3 length of entire spatha, lobe slightly swollen; in ventral view lobe little wider at apex than at base, lobe about twice as wide as width of spatha at middle, lobe with lateral margins inflected about .45 width of spatha almost touching medially, margins parallel at middle slightly divergent elsewhere; ventral hook long, narrow, curved laterad apically;

aedeagal apodeme wide basally, with rounded swelling ventrally, dorsal margin evenly curved.

Coloration. Black with yellow markings more or less developed as follows: inner orbit; subantennal area; median interantennal spot; distal margin of clypeus; ventral surface of scape; median area of pronotal keel; tegulae; portions of dorsal margin of metanotum; anteroventral surface of coxae and trochanters; portions of ventral surfaces of femora; apical margins of terga 1-6, sterna 2-6; tergum and sternum 7. Flagellum light ferruginous. Apex of mandible and legs dark brown. Wings dark yellow to ferruginous, darker apically.

TYPE MATERIAL. I have not been able to locate Latreille's types of *leche-guana*. Buysson (1905) indicated that they were in the Paris Museum and had the following labels: "Rio Grande, ouest de la Capitainerie des Mines, Nord de la Capitainerie de Saint-Paul, sud de la Capitainerie de Goyaz." They were collected by A. de Saint Hilaire in 1815 and 1820 at the same time that the types of *augusti* were collected.

Spinola's types of *Brachygastra velutina* have been compared with specimens of *leche-guana* and do not differ significantly. His species has often been considered a variety of *leche-guana* on the basis of the "corps velouté," but I have found the velvety appearance to be striking only in relatively newly emerged wasps in which there was no wing wear. Specimens with worn wings have hairs much shorter and consequently a slightly different appearance.

A male "type" of *Nectarinia binotata* Saussure is in the Paris Museum but it has a different label ("Colombie, C. Parzudacki, 1840") than Saussure's original indication ("Cayenne"). Although the genitalia have not been examined it agrees closely with other males of *leche-guana*.

VARIATION. The characters that vary in this species are the same as those in *mellifica*, but the range of variation is much greater. The form of the scutellum ranges from a strongly emarginate posterior margin (Fig. 12), to the most common condition of *mellifica*, i.e. a straight posterior margin. Separation of these forms, therefore, may be difficult unless males are available. The shape of the scutellum does not vary on a geographical basis only; it is often possible to find several situations at one locality. The most common condition in South America is a distinct, but not deep, V-shaped emargination of the posterior margin of the scutellum, but in Argentina and Paraguay there is a high percentage of specimens with a straight posterior margin. Many specimens from northern Bolivia and the western Amazon Basin have a deep emargination.

In Panama and northwestern South America the *leche-guana* population is strikingly different and deserves special consideration here. In central Panama, almost all *leche-guana* specimens have a distinctly emarginate scu-

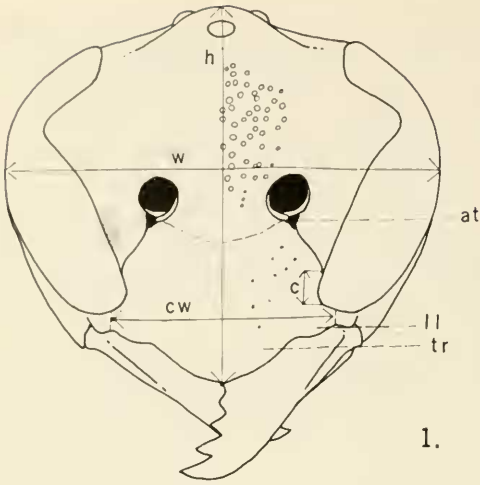
tellum which is also narrowed posteriorly giving the structure a biangulate appearance (Fig. 12, 14). The structure is also relatively higher than most specimens of *lecheгуana* in South America and *mellifica* in Central America (Fig. 10). In addition, one male* examined had a very wide spiculum and somewhat different proportions of the digital lobe and the parameres (Figs. 19-21). Four additional males, however, show that these characters vary somewhat and may not be indicative of a distinct population. Females, although distinct in central Panama, are not always readily separable from *mellifica* to the North and appear to grade into the condition of the South American forms in eastern Colombia and Venezuela. In western Colombia and Ecuador, however, they are distinct from populations east of the Andes. I do not feel justified at present in separating this population without the examination of more males. I have included it in *lecheгуana* because of the similarities of the male genitalia, but as noted above, females very much resemble southern forms of *mellifica*.

The width of the abdominal bands does not vary noticeably, but the maculations on the head and thorax vary in size. The majority of the wasps lack the latter markings entirely, but some specimens in Panama have yellow on the axillar ridges and the dorsal surface of the scutellum. In Argentina many wasps have dense punctures and long hairs similar to those in *borellii*.

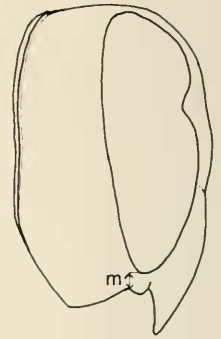
DISTRIBUTION. *Brachygastra lecheгуana* is very common in much of South America south to Buenos Aires but not south of Ecuador west of the Andes. It appears to be a characteristic of drier forests and open savannas where its nests are conspicuous in high trees. It may also occur in more humid, forested areas but is never as abundant in these habitats.

Specimens have been examined from the following localities: *Argentina*. Prov. Buenos Aires: Buenos Aires; (Delta de Buenos Aires; Ezeiza; Gen. Pacheco); San Isidro; (Tigre). Prov. Catamarca: (El Cavillo); La Merced, Prov. Chaco; Resistencia; (Río Ducle). Prov. Cordoba: Capilla del Monte; Córdoba; Cosquín; Cruz del Eje; (La Bahamondes). Prov. Formosa: (Espinillo; Gran Guardia; Laguna de Blanca; Tres Isletas). Prov. Jujuy: (Dique la Cienaga); Jujuy. Prov. La Rioja. Prov. Misiones: (Loreto); Obera; Río Iguazú. Prov. Salta: (Cabeza de Buey; Potrero de Linares; Río Blanco); Salta; San Bernardo. Prov. Santa Fé: (La Gallereta); Reconquista; Villa Ana; Villa Guillermina. Prov. Santiago del Estero: Colonia Jaime. Prov. Tucumán: Tafí Viejo; Trancas; Tucumán. *Bolivia*. Dept. Beni: (Ivoñ); Tumupasa. Dept. Santa Cruz: (Prov. del Sara); Roboré. *Brazil*. Est. Amazonas: Manaus. Est. Ceará: Quixeramobim. Est. Goiás: Anápolis; 5 mi. E. of E. branch Rio Araguaia between Loroti and Rio Formosa; Jatai; Santa Isabel. Est. Guaporé: Pôrto Velho. Est. Mato Grosso: Chapada; Pôrto Velho; Salobra; Utiariti on Rio Papagaio. Est. Minas Gerais: Pouso Alegre. Est. Nova Teutonia: Cauna; (Pinhal); Santa Catarina. Est. Pará: Belém; Lower Rio Liberdade. Est. Paraíba: Mun. Soledade, Joazeirinho. Est. Paraná: Curitiba. Est. Pernambuco: Bonito. Terr. Roraima [= Terr. Rio Branco]: Carmo (Island); Santa Maria; Vista Alegre. Est. São Paulo: Barretos; Baueri; Batatais; Bauru; Campos do Jordão; (Eng. Cesar de Souza); Faz. do Bonito, Serra da Bocaina; (Fas. Pau d'Alho-Itú); Ipiranga; Monte Alegre, 750 m; Santa Amara (Island); São Carlos, São Paulo. *British Guiana*. Essequibo Co.: (Ondercmeing); Rio Essequibo. *Colombia*. Dept. Antioquia; Puerto Berrio. Dept. Atlantico: Puerto Colombia. Dept. Bolivar: Cartagena. Dept. Huila: Villavieja. Dept. Magdalena: Atlantico 200 m; Barranquilla; Cienaga; Río Frio; Santa Marta. Dept. Meta: Restrepo, 500 m; Villavicencio. Dept. Santander: (Boca del Rosaria). Dept. Tolima: 11 mi. E. Ibaque. *Costa Rica*. Alajuela Prov.: Orotina. Puntarenas Prov.: Palmar. *Ecuador*. Prov. Quayas: Quayaquil; 3 mi. N. Manglar, Alto Guayas.

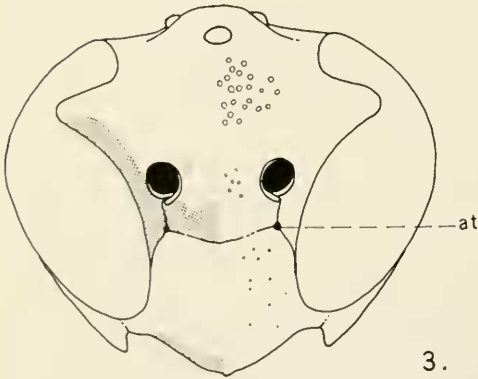
* In the American Museum of Natural History.



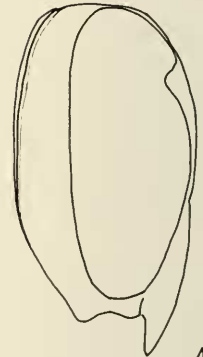
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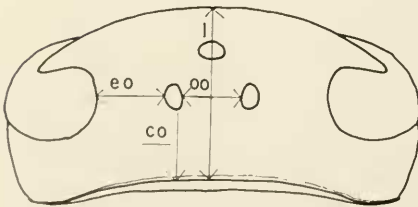
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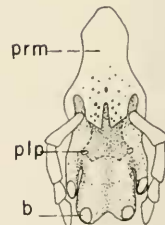
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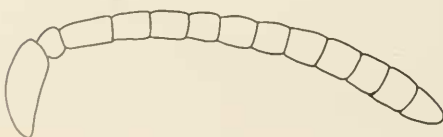
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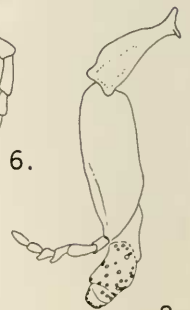
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French Guiana. Dist. Guayane: Cayenne. *Panama.* Canal Zone: Ancón; Barro Colorado Island; Corozal; Ft. Clayton; Gamboa; Juan Mina. Prov. Chiriquí: Boquete; Potrerillos. Prov. Colón: Santa Rosa. Prov. Coclé: Penonome; Calhajuelo. Prov. Panama: Panama; Sabanas. *Paraguay.* Dept. Alto Paraná; Puerto Bertoni. Dept. Caagazú: Tacuara. Dept. Guairá: Villarica. Dept. La Cordillera: San Bernadino. Dept. San Pedro: Independencia; (Paso Yobay). *Peru.* Dept. Cajamarca: Pacasmayo. Dept. Loreto: Río Putumayo, near Taona; Río Ucayali, Middle. Dept. Piura: Queb. Tamarindo, Anotape Mts. Dept. Tumbes: Tumbes. (San Antonio on Río Cotuhe; Río Cliotano; Yeguestesque). *Surinam.* Dist. Commewijne: Matapica. Dist. Marowijne: Albina; Moengatapoe. Dist. Suriname: Braamspunt; Kwakoepron; Paramaribo. (Boskamp; Lelydorp). *Venezuela.* Est. Barinas: Barinas; San Silvestre. Est. Bolívar: Cuidad Bolívar; Suapure on Río Caura. Terr. Delta Amacuro: 140 km. N.E. Barrancas on Caño Mariusa. Dist. Federal: Caracas. Est. Trujillo: Valera. Est. Zulia; Encontrados; Río Negro.

BIOLOGY. Owing to its interesting habit of storing large amounts of honey in its nest, this species was noted in the literature as early as 1648. Early accounts of honey storing bees and wasps undoubtedly refer in part to *B. lecheguana*. Bequaert (1932) gives an excellent history of the knowledge of this species and the reader is referred to his work for a more detailed account of the reference to *lecheguana*.

The nest is like that of *mellifica* and may become very large. R. von Ihering (1904) described a nest from São Paulo consisting of 20 combs and measuring 27 by 39 cm. According to Bertoni (1912) the nest is very common in Paraguay and can be found low in the underbrush and grasses where it may reach a diameter of 30 cm. It is generally spherical to elongate and has several entrances. The internal structure is phragmocytтарous like *mellifica*, and the cells are 4.5 mm. wide and 6.7 mm. deep. The full grown larva spins a cap 4.5 mm. high over this cell.

The colonies are founded by swarms and are perennial. The wasps are able to withstand low temperatures (-5° C.) and, according to Wagner, retreat into the cells with only the tips of the abdomens protruding during the winter.

Brachygastra borellii (Zavattari)

(Fig. 65)

Caba borellii Zavattari, 1906. Boll. Mus. Anat. Comp. Torino 21(523):1.

Nectarina lecheguana var. *borellii*, Ducke, 1910. Ann. Mus. Nat. Hungarici 8:482.

Brachygastra lecheguana var. *borelli*, Willink, 1952. Acta. Zool. Lilloana (Tucumán) 10:146.

FIG. 1. Frontal view of head of female *B. lecheguana*. at=anterior tentorial pit; c=contact with eye; cw=width of clypeus; h=height of head; ll=lateral lobe of clypeus; tr=apical triangle of clypeus; w=width of head.

FIG. 2. Lateral view of head of female *B. lecheguana*. m=malar space.

FIG. 3. Frontal view of head of *B. lecheguana*. at=anterior tentorial pit.

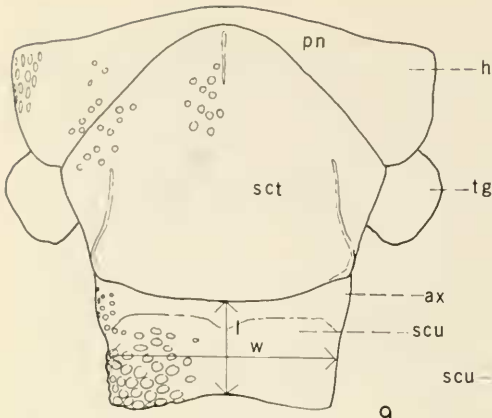
FIG. 4. Lateral view of head of male *B. lecheguana*.

FIG. 5. Dorsal view of head of female *B. lecheguana*. eo=distance between eye and lateral ocellus; co=distance between occipital carina and lateral ocellus; l=length of head; oo=distance between lateral ocelli.

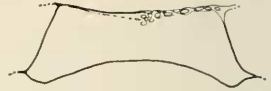
FIG. 6. Caudal view of labium of *B. lecheguana*. b=acroglossal button; plp=posterior lingual plate; prm=prementum.

FIG. 7. Antenna of male *B. lecheguana*.

FIG. 8. Caudal view of right maxilla of *B. lecheguana*.



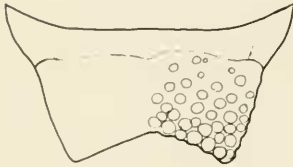
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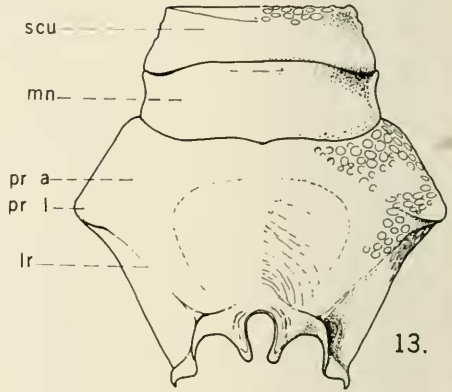
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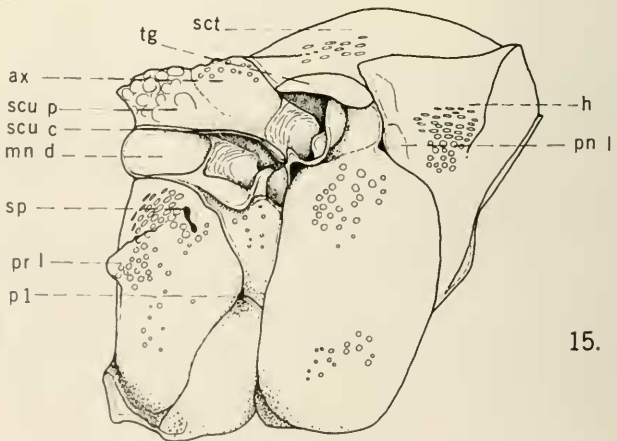
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Because *borellii* was described from a single female and is not in most collections, both Ducke and Bequaert thought it to be an "aberration" of *lecheaguana*. Willink (1952), after examining two additional specimens from northern Argentina, concluded that Zavattari's species was a variety of *lecheaguana*. Additional material from Bolivia and Argentina seems to indicate that it has a much wider range than originally expected and that it may, in fact, be a distinct species. Although it is similar to *lecheaguana* with respect to most characters, *borellii* is quite unique on the basis of pubescence and punctations.

Brachygastra borellii is best distinguished from *lecheaguana* by the very long, yellow hairs and the dense, deep punctures on the head and thorax. It is an entirely black wasp, the yellow markings only faintly appearing on the apical margin of the second tergum. The wings are dark and relatively long, extending a considerable distance beyond the abdomen. In addition, the dense, punctured, rugose surface of the metanotum is unique and will separate *borellii* from other species (Fig. 11).

FEMALE. (1.) Wing length 7.98 mm.

Head. (2.) In frontal view .88 times as high as wide; in dorsal view about .42 times as wide as long; posterior margin slightly curved. (3.) Lateral ocellus separated from eye by 1.45 distance between lateral ocelli and from occipital carina by 1.41 this distance; vertex with medium sized deep punctures separated by less than one diameter, usually contiguous; vertex strongly convex, posterior surface sloping ventrad in profile. (4.) In lateral view gena about 1.3 times as wide as eye in middle; postgenal convexity absent, ventral half of posterior margin of gena straight, gena widest at middle; gena about as wide on ventral half as at level of eye emargination; punctures medium sized, separated by about one to two diameters, evenly spaced on entire gena. (5.) Occipital carina forming an acute ridge about 0.3 times as high as width of ocellus, slightly lower medially, extending to mandibular condyle. (6.) Frons with dense, contiguous, medium sized punctures. (7.) Clypeus about

FIG. 9. Dorsal view of thorax of *B. lecheaguana*. ax=axilla; h=humeral angle; l=length of scutellum; pn=pronotum; sct=scutum; scu=scutellum; tg=tegula; w=width of scutellum.

FIG. 10. Caudal view of scutellum of *B. lecheaguana*, Panama Canal Zone.

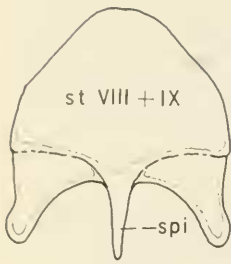
FIG. 11. Caudal view of scutellum and metanotum of *B. borellii*.

FIG. 12. Dorsal view of scutellum of *B. lecheaguana*, Panama, Canal Zone.

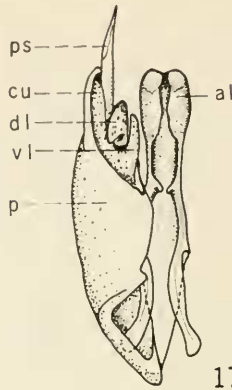
FIG. 13. Caudal view of thorax of *B. lecheaguana*. lr=lateral ridge of propodeum; mn=metanotum; pr a=propodeal angle; pr l=propodeal lobe; scu=scutellum.

FIG. 14. Lateral view of scutellum of *B. lecheaguana*, Panama, Canal Zone.

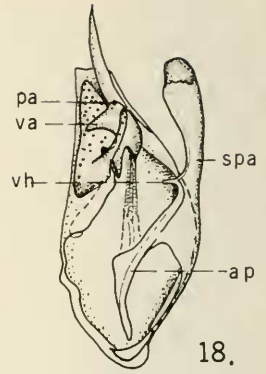
FIG. 15. Lateral view of thorax of *B. lecheaguana*. ax=axilla; h=humeral angle; mn d=metanotal depression; p l=first metapleural pit; pn l=pronotal lobe; pr l=propodeal lobe; sct=scutum; scu c=scutellar crest; scu p=scutellar pocket; tg=tegula.



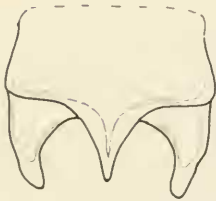
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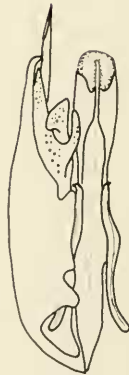
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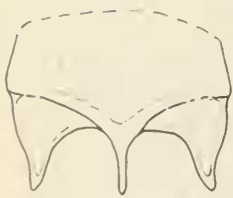
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1.7 times as wide as long, slightly convex; distal margins curved, broadly rounded onto lateral lobes; apical triangle short, about 0.8 times as long as width of antennal socket, apex broadly rounded; contact with eye equal to about 0.8 width of antennal socket; epistomal suture forming about a 45° angle with eye margin, dorsally, scarcely evident, broadly curved ventrad; clypeal surface occasionally irregular, somewhat shiny, with small punctures separated by about two diameters basally, larger, almost contiguous apically, almost entirely sericeous. (8.) Malar space about 0.4 width of antennal socket. (9.) Antenna with flagellum moderately swollen, eighth flagellomere about 1.5 times as wide as long. (10.) Head with abundant, long, erect, golden hairs little more than twice as long as width of ocellus, longer on vertex than elsewhere; eye with abundant hairs about as long as width of ocellus; head very lightly sericeous.

Thorax. (11.) Anterior surface of pronotum with few scattered punctures dorsally, distinctly separated from dorsal surface of pronotum; pronotal keel low, of even height, acute, extending to humeral angle only, absent on lateral surface; humeral angle not well developed, rounded; dorsal surface abruptly rounded onto lateral surface; lateral surface not distinctly separated from anterior surface, with medium sized punctures separated by about one diameter; pronotal lobe wide, distinct. (12.) Scutum about 0.9 times as long as wide, with evenly spaced, medium sized punctures separated by one to two diameters. (13.) Scutellum in dorsal view about twice as wide as long, slightly bilobed, only slightly shorter at middle than at lateral margin, posterior margin forming a slight V; in posterior view, about 5 times as wide as high at middle, dorsal margin almost straight, slightly depressed medially; in profile, scutellum angular, not raised above plane of scutum, extending slightly over plane of metanotum; dorsal surface flat to slightly convex,

FIG. 16. Dorsal view of sternum VIII + IX and spiculum of *B. lecheguana*. spi=spiculum.

FIG. 17. Ventral view of aedeagus and left paramere of *B. lecheguana*. al=aedeagal lobe; cu=cuspis; dl=digital lobe; p=paramere; ps=parameral spine; vl=volsellar lobe.

FIG. 18. Mesal view of aedeagus and left paramere of *B. lecheguana* (aedeagus displaced dorsad). ap=aedeagal apodeme; pa=posterior angle of digital lobe; spa=spatha; va=ventral angle of digital lobe; vh=ventral hook.

FIG. 19. Dorsal view of base of sternum VIII + IX and spiculum of *B. lecheguana*, Panama, Canal Zone.

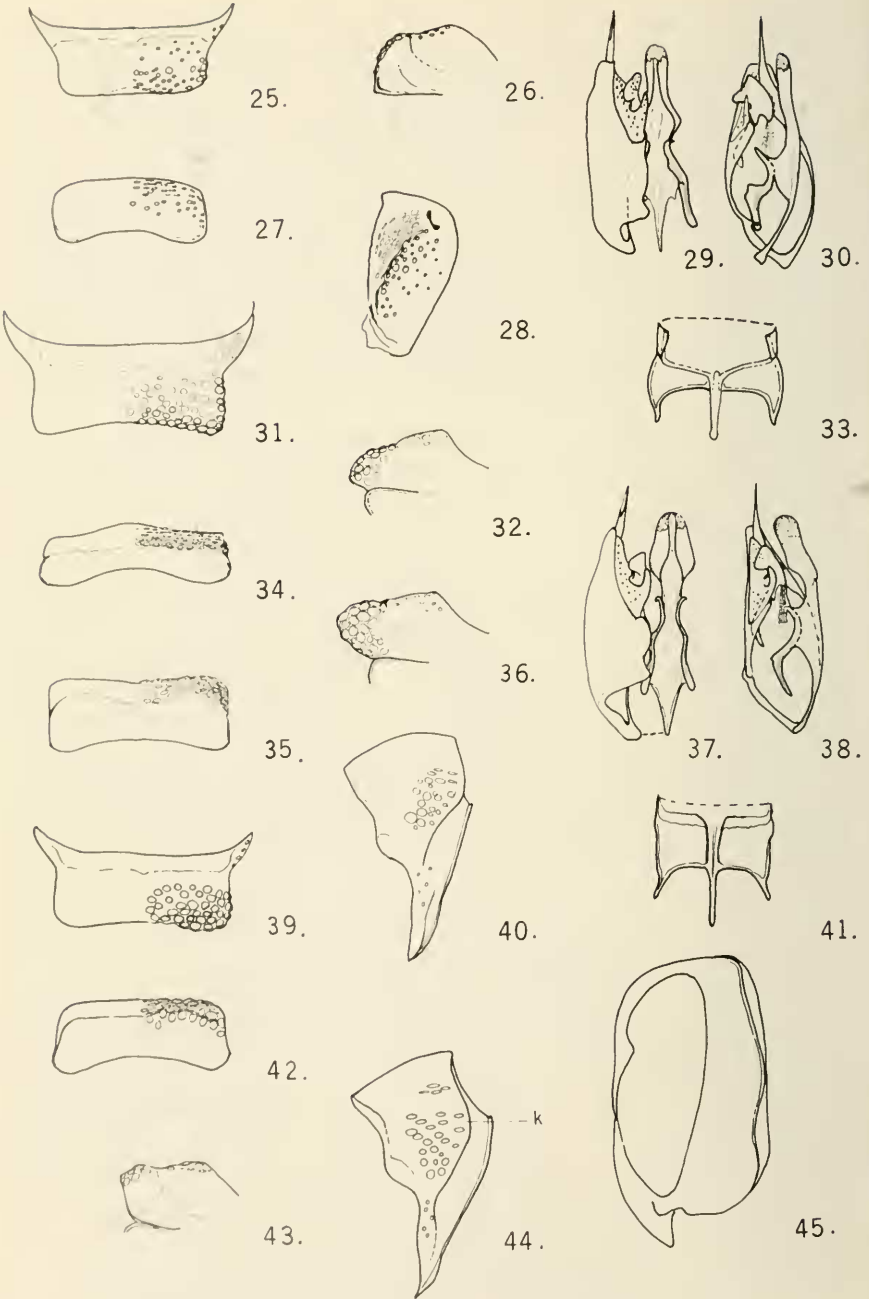
FIG. 20. Ventral view of aedeagus and left paramere of *B. lecheguana*, Panama, Canal Zone.

FIG. 21. Mesal view of aedeagus and left paramere of *B. lecheguana*, Panama, Canal Zone.

FIG. 22. Dorsal view of base of sternum VIII + IX and spiculum of *B. mellifica*.

FIG. 23. Ventral view of aedeagus and left paramere of *B. mellifica*.

FIG. 24. Mesal view of aedeagus and left paramere of *B. mellifica*.



posterior surface flat; scutellar pocket flat, with large contiguous punctures; dorsal surface with large, shallow, contiguous punctures, posterior surface with scattered, medium sized punctures dorsally; axillar ridge very wide, flattened, with small punctures. (14.) Metanotum about 3 times as wide as long, convex; dorsal margin bowed evenly dorsad, ventral margin bowed weakly ventrad; surface punctured, irregularly rugose. (15.) Mesopleuron moderately convex; anterior and posterior surfaces with scattered small punctures; punctures large, shallow, contiguous, forming rugose sculpturing dorsally, punctures medium sized separated by about one diameter ventrally. (16.) Dorsal sclerite of metapleuron twice as high as width at middle, with many small punctures; secondary suture distinct, forming right angle with intersegmental suture; first metapleural pit shallow; ventral sclerite with small punctures separated by one to three diameters; metapleural-propodeal suture evident as a wide, shallow furrow. (17.) Propodeum angular; posterior surface with narrow, deep, median concavity, median area with weak irregular horizontal striations, dorsolateral area with large, shallow, contiguous punctures forming rugose sculpturing; lateral surface with medium

FIG. 25. Dorsal view of scutellum of *B. azteca*.

FIG. 26. Lateral view of scutellum of *B. azteca*.

FIG. 27. Caudal view of scutellum of *B. azteca*.

FIG. 28. Lateral view of propodeum of *B. azteca*.

FIG. 29. Ventral view of aedeagus and left paramere of *B. azteca*.

FIG. 30. Mesal view of aedeagus and left paramere of *B. azteca*.

FIG. 31. Dorsal view of scutellum of *B. fistulosa*.

FIG. 32. Lateral view of scutellum of *B. fistulosa*.

FIG. 33. Dorsal view of base of sternum VIII + IX and spiculum of *B. azteca*.

FIG. 34. Caudal view of scutellum of *B. fistulosa*.

FIG. 35. Caudal view of scutellum of *B. augusti*.

FIG. 36. Lateral view of scutellum of *B. augusti*.

FIG. 37. Ventral view of aedeagus and left paramere of *B. augusti*.

FIG. 38. Mesal view of aedeagus and left paramere of *B. augusti*.

FIG. 39. Dorsal view of scutellum of *B. scutellaris*.

FIG. 40. Lateral view of pronotum of *B. augusti*.

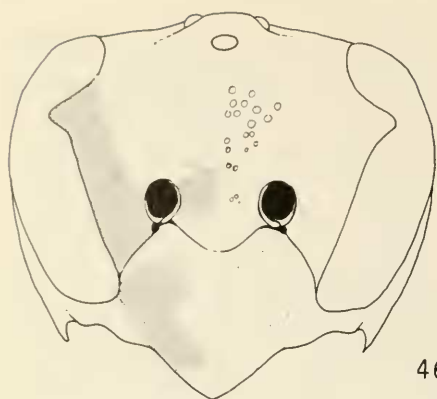
FIG. 41. Dorsal view of base of sternum VIII + IX and spiculum of *B. augusti*.

FIG. 42. Caudal view of scutellum of *B. scutellaris*.

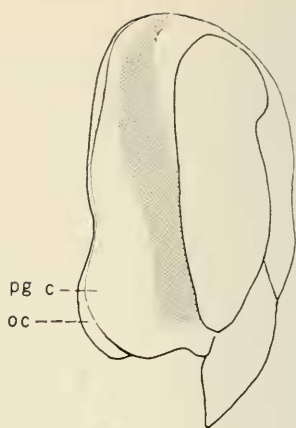
FIG. 43. Lateral view of scutellum of *B. scutellaris*.

FIG. 44. Lateral view of pronotum of *B. scutellaris*. k=pronotal keel.

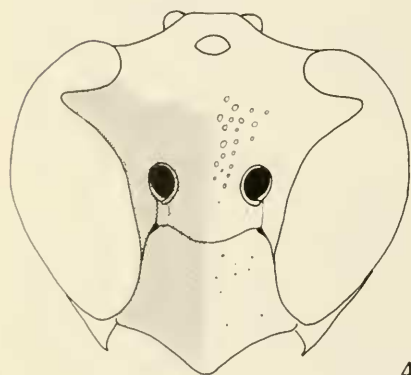
FIG. 45. Lateral view of head of female *B. scutellaris*.



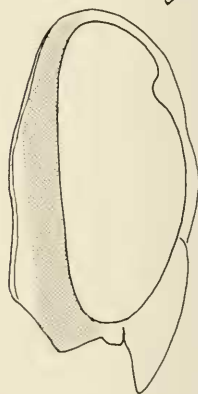
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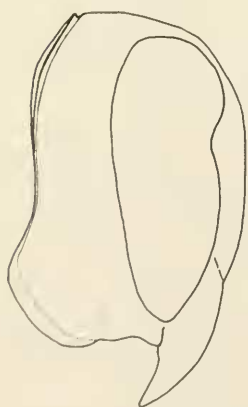
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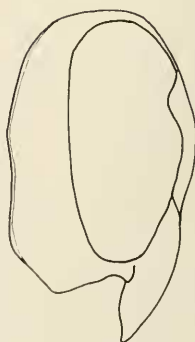
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to large sized punctures separated by one diameter or less, smaller anteriorly and ventrally, rugose posteroventrally; lateral ridge incomplete, present only on propodeal angle; propodeal angle with compressed, blade-like rounded projection, forming prominent round lobe in lateral view, an abruptly truncate, lateral shelf-like ridge in posterior view. (18.) Thorax with abundant long yellow hairs, lightly sericeous.

Abdomen. (19.) Tergum 1 wide, cap-shaped not distinctly set off from tergum 2, about 4.4 times as wide as long; sternum 1 about 4 times as wide as long; tergum with scattered small punctures, sternum rugulose. (20.) Tergum 2 about .86 times as long as wide, low evenly convex in profile; tergum 2 with evenly spaced small punctures separated by about two diameters, sternum 2 with punctures more widely spaced. (21.) Terga and sterna 2-5 with punctures as on 2; tergum and sternum 6 with few small punctures. (22.) Abdomen with abundant yellow hairs directed caudad, about as long as width of ocellus; abdomen lightly sericeous.

Coloration. Almost entirely black, occasionally with very narrow, incomplete yellow apical band on tergum 2. Apex of mandible and tarsi dark brown. Wings brown, veins dark brown.

TYPE MATERIAL. The type, a female from Salta, Argentina, was probably deposited in the Instituto e Museo di Zoologia in Torino, Italy, but it cannot be found there. It is possible that it was destroyed during the war.

VARIATION. Specimens from Bolivia have both humeral and propodeal angles slightly less developed than specimens from Argentina. The propodeal angle is especially well developed in the Argentine specimens and this was the condition in the type; "margini del metatorace compressi formanti un angoli spiniforme acuto ben distinto."

The width and extent of the apical band on the second abdominal segment is quite variable both in Argentina and Bolivia although it is never well developed.

DISTRIBUTION. Although described from Salta, Argentina, additional material from Bolivia indicates that it has a much wider range. It appears to replace *baccalaurea* in the southern Andes as both species are apparently high altitude forms and have not been found together. It is also interesting to

FIG. 46. Frontal view of head of female *B. smithii*.

FIG. 47. Lateral view of head of female *B. smithii*. pg c=postgenal convexity; oc=occipital carina.

FIG. 48. Frontal view of head of male *B. smithii*.

FIG. 49. Lateral view of head of male *B. smithii*.

FIG. 50. Lateral view of head of female *B. buyssoni*.

FIG. 51. Lateral view of head of female *B. bilineolata*.

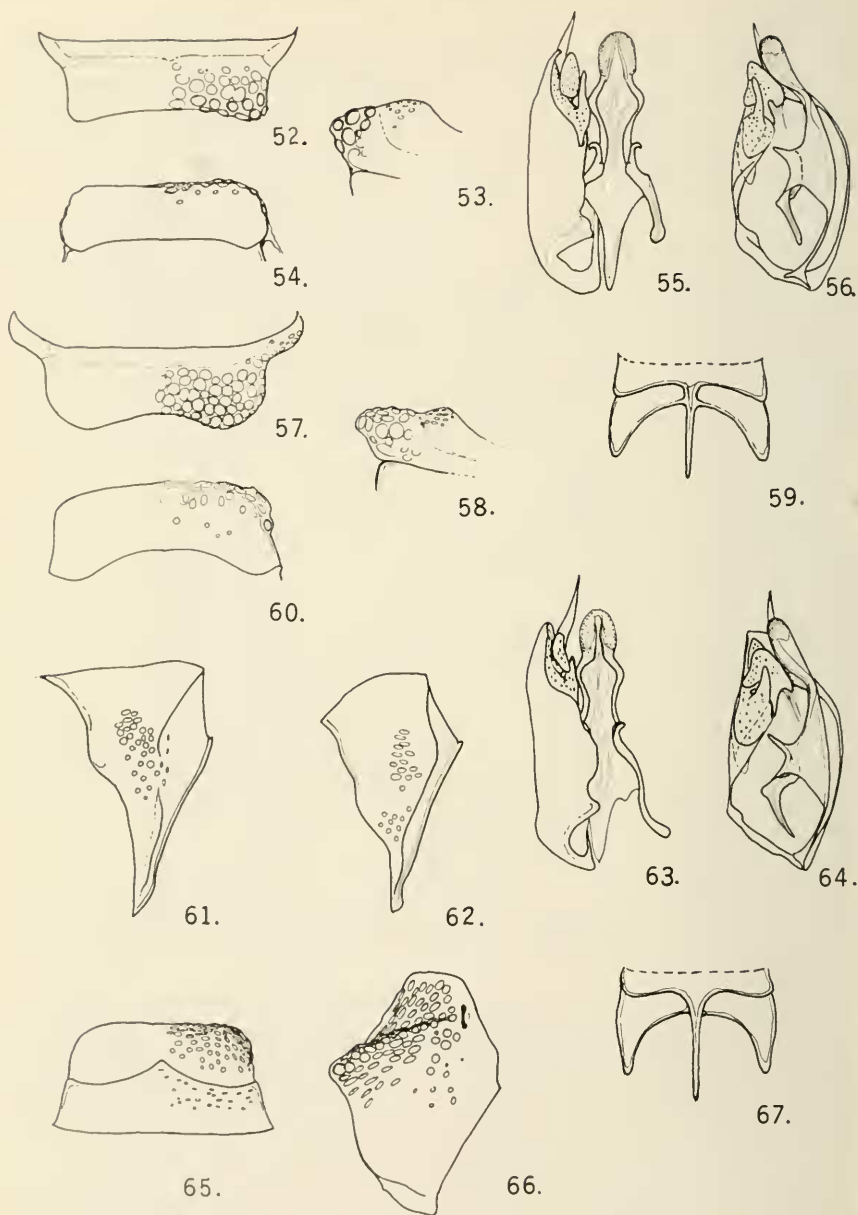


FIG. 52. Dorsal view of scutellum of *B. bilineolata*.

FIG. 53. Lateral view of scutellum of *B. bilineolata*.

FIG. 54. Caudal view of scutellum of *B. bilineolata*.

FIG. 55. Ventral view of aedeagus and left paramere of *B. bilineolata*.

note that both wasps have the extremely melanic pigmentation and the well developed pubescence often characteristic of high altitude species.

I have seen specimens from the following localities: *Argentina*. Salta Prov.: Abra Santa Laura. Jujuy Prov.: Lagunas de Yala. *Bolivia*. Dept. Cochabamba: Cochabamba, 2,600 m.

Schrottky (1913) reported *borellii* from Tucumán, Argentina, about 140 mi. southwest of the type locality.

SELECTED REFERENCES

- BEQUAERT, J. C. 1933. The nearctic wasps of the subfamily Polybiinae. *Ent. Amer.* 13:87-150.
 ———. 1943. New and imperfectly known neotropical Polybiinae. *Jour. New York Ent. Soc.* 50:295-308.
 ———. 1944. The social Vespidae of the Guianas, particularly of British Guiana. *Bull. Mus. Comp. Zool. Harvard* 94:249-304.
 BERTONI, A. DE W. 1911. Contribución à la biología de las avispas y abejas del Paraguay. *An. Mus. Nac. Buenos Aires* 15:97-146.
 BODKIN, G. E. 1917. Notes on some British Guiana Hymenoptera (exclusive of Formicidae). *Trans. Ent. Soc. London* 1917:297-321.
 BUYSSON, R. DU. 1905. Monographie des Vespides du genre *Nectarina*. *Ann. Soc. Ent. France* 74:537-566.
 CURTIS, J. 1844. Descriptions of the nests of two Hymenopterous insects inhabiting Brazil, and of the species by which they were constructed. *Trans. Linnean Soc. London* 19:249-259.
 DALLA TORRE, C. G. DE. 1894. *Catalogus Hymenopterorum* vol. 9, 184 pp.
 DUCKE, A. 1904. Sobre as Vespidas sociaes do Pará. *Bol. Mus. Goeldi* 4:317-371.
 ———. 1905. Nouvelles contribution à la connaissance des vespides sociaux de l'Amérique du Sud. *Rev. Ent. (Caen)* 24:5-24.
 ———. 1905a. Sobre as Vespidas sociaes do Pará (I Suplemento). *Bol. Mus. Goeldi* 4:652-698.
 ———. 1906. Contributions à la connaissance de la faune Hyménoptérologique du Brésil central e méridional. *Rev. Ent. (Caen)* 25:5-11.
 ———. 1907. Novas contribuições para o conhecimento das Vespas do região neotropical. *Bol. Mus. Goeldi*. 5:152-199.
 ———. 1908. Beitrage zur Hymenopterenkunde Amerikas. *Deutsch. Ent. Zeitschr.* 1908:695-700.
 ———. 1910. Revision des guêpes sociales polygames d'Amérique. *Ann. Mus. Nat. Hungarici* 8:449-544.

FIG. 56. Mesal view of aedeagus and left paramere of *B. bilineolata*.

FIG. 57. Dorsal view of scutellum of *B. smithii*.

FIG. 58. Lateral view of scutellum of *B. smithii*.

FIG. 59. Dorsal view of base of sternum VIII + IX and spiculum of *B. bilineolata*.

FIG. 60. Caudal view of scutellum of *B. smithii*.

FIG. 61. Lateral view of pronotum of *B. baccalaurea*.

FIG. 62. Lateral view of pronotum of *B. smithii*.

FIG. 63. Ventral view of aedeagus and left paramere of *B. smithii*.

FIG. 64. Mesal view of aedeagus and left paramere of *B. smithii*.

FIG. 65. Caudal view of scutellum and metanotum of *B. baccalaurea*.

FIG. 66. Lateral view of propodeum of *B. buyssoni*.

FIG. 67. Dorsal view of base of sternum VIII + IX and spiculum of *B. smithii*.

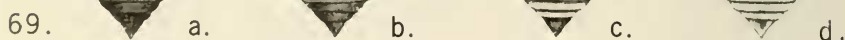
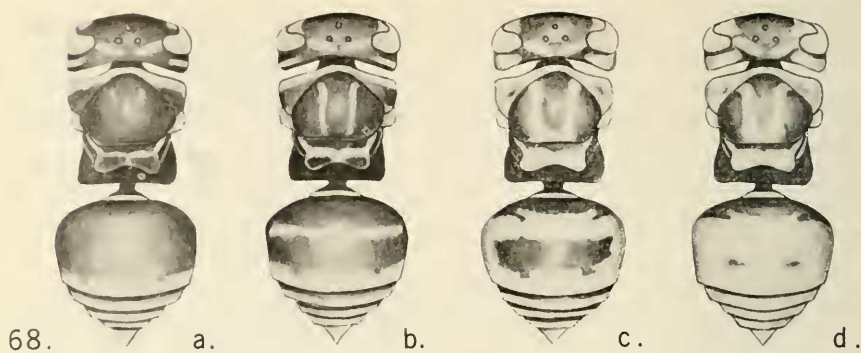


FIG. 68. Color variation in *B. bilineolata* in northern Surinam. a. Paramaribo; b. Blauwgrond; c. Republic; d. Zanderij.

FIG. 69. Color variation in *B. scutellaris* in Colombia. a-b. Restrepo, Dept. Meta; c-d. Muzo, Dept. Boyaca.

———. 1914. Über Phylogenie und Klassifikation der Sozialen Vespiden. Zool. Jahrbuch. (Syst.) 36:304-330.

———. 1918. Catalog das Vespas Sociales do Brazil. Rev. Mus. Paulista, 10:314-374.

DOYER, C. 1924. Notes on the genus *Nectarina* Shuckard. Psyche, 31:305-307.

DUNCAN, C. D. 1939. A contribution to the biology of North American vespine wasps. Stanford Univ. Publ. Biol. Sci. 8:1-90.

ENTLMAN, W. M. 1904. Coloration in *Polistes*. Carnegie Inst. Washington, Publ. No. 19.

ERICHSON, W. F. 1848. Reisen in British-Giana in den Jahren 1840-1844 im Auftrag Sr. Majestat des König von Preussen ausgeführt von Richard Schomburgk. III Insekten. Leipzig, Weber.

FABRICIUS, J. C. 1804. Systema Piezatorum. Brunsvigae, Reichard.

HIERING, R. VON. 1896. Zur biologie der sozialen Wespens Brasiliens. Zool. Anz. 19:449-453.

———. 1903. Contribution à l'étude des Vespides de l'Amérique du Sud. Ann. Soc. Ent. France 72:144-155.

———. 1904. As vespas sociales do Brazil. Rev. Mus. Paulista 6:97-309.

LATREILLE, P. A. 1824. Notice sur un insecte Hyménoptère de la famille des Diptoptères,

connu dans quelques parties du Brésil sous le nom de guêpe lecheguana et récoltant du miel. Mém. Mus. Hist. Nat. 11:313-318.

- MÖBIUS, K. A. 1856. Die Nester der geselligen Wespen. Abhandl. Naturw. Ver. Hamburg. 3:121-171.
- PERTY, MAXIMILIANUS. 1830-1834. Delectus animalium articulatorum quae in itinere per Brasiliam annis 1817-1820, jussu et auspiciis Maximiliani Josephi Bavariae regis augusti peracto, colligerunt Dr. J. B. de Spix et Dr. C. F. de Martius, 1830-1834.
- PROVANCHER, L. A. 1889. Additions et Corrections au Volume II de la Fauné Entomologique du Canada Traitant des Hyménoptères. C. Darveau, Quebec, 475 pp.
- RICHARDS, O. W. AND M. J. RICHARDS. 1951. Observations on the social wasps of South America. Trans. R. Ent. Soc. London 102:1-170.
- RUDOW, M. 1898. Einige ausländische Nester von Hautflüglern. Illus. Zeitsch. Ent. 3:24-26.
- SAUSSURE, H. DE. 1853-1858. Etudes sur la famille des Vespides 2. Monographie des guêpes sociales ou de la tribu de Vespiciens. Paris and Geneva. 4+cxix+256 pp., 39 pls.
- SAUSSURE, H. DE. 1857. Nouveaux Vespides du Mexique et de l'Amérique septentrionale. Rev. Mag. Zool. Paris 9:269-280.
- . 1867. Reise der österreichischen Fregatte Novara. Band II. Hymenoptera. Vienna, 1867.
- SAY, THOMAS. 1837. Descriptions of new species of North American Hymenoptera, and some observations on some already described. Boston Jour. Nat. Hist. 1:361-416.
- SCHWARZ, H. F. 1929. Honey wasps. Natural History 29:421-426.
- SCHULZ, W. A. 1903. Kritische Bemerkungen zur Hymenopterenfauna des nordwestlichen Sudamerika. Berliner Ent. Zeitsch. 48:253-262.
- . 1904. Hymenoptera Amazoniens. Sitz. B. Akad. Wiss. Munchen 33:757-832.
- SMITH, F. 1857. Catalogue of the Hymenopterous insects in the collection of the British Museum. V. Vespariae. London, 147 pp.
- SPINOLA, M. 1841. Hyménoptères recuilles á Cayenne en 1839 par M. Leprieur. Ann. Soc. Ent. France 10:85-149.
- . 1853. Compte rendu des Hyménoptères inédits provenant du voyage entomologique de Mr. Ghiliani dans le Para en 1846. Mem. R. Accad. Sci. Torino 13:19-94.
- SWAINSON, W. AND W. E. SHUCKARD. 1840. On the History and Natural Arrangement of Insects. Cab. Cyclop. Hist. Nat. no. 129, London.
- VESEY-FITZGERALD, D. 1938. Social wasps from Trinidad, with a note on the genus *Trypoxylon* Latr. Trans. R. Ent. Soc. London. 87:181-191.
- WHITE, A. 1841. Description of a South American Wasp which collects honey. Ann. Mag. Nat. Hist. 7:315-322.
- WILLINK, A. 1952. Los véspidos sociales argentinos, con exclusión del genero *Mischocyttarus*. Acta. Zool. Lilloana (Tucumán) 10:105-151.
- WYTSMAN, P. 1904. Genera Insectorum 19. Vespidae, Bruselles, 88 pp.
- ZAVATTARI, E. 1906. Descrizione di due nuove specie di Vespidi dell'America Meridionale. Boll. Mus. Anat. Comp. Torino. 21:1-4.